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ABSTRACT

This curriculum guide was prepared to help Connecticut high schools offer an opportunity to disadvantaged high school students who are interested in home economics education to earn some college credit toward a degree in dietetic technology. The curriculum guide includes an overview of the course with a course description, recommended textbooks, objectives, outline, and evaluation methods. The nine units of the course cover the following topics: how food affects you; rating yourself nutritionally; physiology for nutrition; water; carbohydrates; lipids; proteins; vitamins; and minerals. Each unit consists of a behavioral objective, suggested evaluation, learning activity/resource, pretest, content related to the suggested texts, study vocabulary, and suggestions for evaluation. Expected outcomes and a list of available resources are listed. A comprehensive examination completes the course. (KC)

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A Plan to the Future in Home Economics Education
Draft Curriculum

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A. PURPOSE

The primary purpose of this project is to offer disadvantaged high school students who are interested in various areas of home economics education an opportunity to earn some college credit toward a degree in Dietetic Technology.

B. OBJECTIVES

1. To evaluate existing home economics curriculums in the New Haven School System.
2. To recommend modification to those home economics courses designated for some college credit.
3. To seek formal approval from both sponsoring agencies.
4. To introduce the curriculum for the 1988-89 academic year.

After reviewing the courses in the Associate in Science degree program for Dietetic Technology and the Home Economics programs, the project leaders decided to design the equivalent of the first semester nutrition course (Nutrition Care I) in the high school as an advanced home economics course. Students who complete the high school course with a minimum grade of "C" and pass the comprehensive advanced placement test will be awarded 3 credits toward the Dietetic Technology program.

The curriculum and final exam are included here. Upon approval from the Department of Education, teachers will be given in-service training on the new curriculums and technical assistance throughout the year as needed. Counselors will be involved in recruiting students for the programs. SCCC already has a recruitment brochure for the program, and others will be developed as needed. Both formal and informal evaluations will be conducted periodically by representatives of the College and the secondary school, to monitor student progress in the required concepts.

C. OVERVIEW OF COURSE

Title: Living Nutrition

Course Description: This course is primarily designed for students who wish to major in dietetics at South Central Community College. The course covers the fundamentals of nutrition and enables the students to use these concepts to make healthier food choices.

Textbooks: -Christian, Janet L. and Greger, Janet L. : Nutrition for Living, 2nd ed., Menlo Park, CA: Benjamin/Cummings Publishing Co., Inc., 1988 (ISBN 0-8053-2006-7)
-Nitzke, Susan A.: Study Guide to Accompany Nutrition for Living, 2nd ed. (ISBN 0-8053-2007-5)
-Nitzke, Susan A.: Instructor's Guide to Accompany Nutrition for Living, 2nd ed. (ISBN 0-8053-2008-3)

Objectives: Please see each unit for specific objectives.

Outline:

Ch. 1	How Food Affects You	Unit 1
Ch. 2	Rating Yourself Nutritionally	Unit 2
Ch. 3	Physiology for Nutrition	Unit 3
Ch. 4	Water: Not to be Taken for Granted	Unit 4
Ch. 6	Carbohydrates	Unit 5
Ch. 7	Lipids	Unit 7
Ch. 8	Proteins	Unit 6
Ch. 12	Vitamins	Unit 9
Ch. 13	Minerals	Unit 8

Evaluation:

Tests	70%
Projects	20%
Attendance/Participation	10%

Students must pass the course with a "C" or better, and pass the advanced placement exam with a "C" or better, to obtain college credit for the course.

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ii.

Living Nutrition

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UNIT 1

HOW FOOD AFFECTS YOU
BEHAVIORAL OBJECTIVE - The Student will know nutrient classification, purposes in the body, consequences of inadequacies and excesses, intake standards, timing of nutrition effects, and types of studies.
MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. To demonstrate relationship of nutrients and the human body B. To demonstrate how inadequacies and excesses can be harmful to the body C. To demonstrate standards of nutrient intakes D. To demonstrate nutrition effects over periods of time E. To understand the effects of nutritional studies	
II. Pre-test	Teacher made
III. Content A. Human Body 1. Chemical balance a. 27 elements found in human body b. body needs nutrients (compounds and elements) for growth and health c. 6 classes of nutrients i. macronutrients-water, carbohydrates, lipids and proteins ii. micronutrients-vitamins and minerals	Nutrition for Living pgs. 5-22
B. Nutrients functions 1. Forming body structures a. water, proteins, lipids, minerals contribute to body formation; also affected by genetic make up	Building for Health Laidlaw Series
2. Providing energy a. energy provided by foods is measured in kilo calories (kcalories) b. carbohydrates and proteins produce 4 kcalories per gram c. fat produces 9 kcalories per gram d. alcohol (not a nutrient) produces 7 kcalories per gram	Nutritive Value of Common Foods University of Arkansas
3. Regulate body process a. vitamins and minerals are not energy providers but are involved in reactions that generate energy from other nutrients b. some minerals and proteins regulate water distribution and body fluids acidity	

4. Nutrient inadequacies and excesses
   a. total lack of some nutrients result in growth failure, nonreproduction and death
   b. partial lack of nutrients result in stunt growth, infections, weight loss, poor work capacity
   c. restriction of a single nutrient causes more specific defects
   d. nutrient excesses usually caused by overdosing with supplements
   e. more is not usually better
5. Standards
   a. recommended dietary allowances (RDAs) for U.S. are revised about every five years by National Academy of Science
   b. Canada uses similar standards
   c. standards are stated in metric units (grams) for special age/sex categories — RDA Chart
   d. all RDAs are set high enough for 97.5% of all healthy people in each age/sex/reproductive status
      i. energy RDAs are estimates of average kcalorie needs for each category
      ii. RDAs do not consider special needs due to injury or illness
   e. recommendations vary from country to country based on scientific judgment
   f. "safe and adequate" intake ranges reflect uncertainty in some nutrient recommendations added to latest RDA edition (1980)
   g. new RDAs were not released in 1985 due to scientific disagreement
   h. U.S. RDAs are standards for labeling
      i. U.S. RDAs are based for anyone 4 years old through adulthood (except pregnant and lactating women)
      ii. labeling allows nutrient comparison between products
      iii. labeling is required for added nutrients and foods that have nutritional claims
6. Nutrition effects over time periods
   a. short term nutritional effects happen within minutes or hours of consumption (e.g., sugar/water) — Sports Medicine
   b. intermediate nutritional effects take weeks or months
      i. example: bleeding guns, vitamin C deficiency, can happen in a few months with total lack of vitamin C--symptoms can be revised in a few days with vitamin C

ii. example: excess kcalories become extra body fat in weeks or months

c. Long range nutritional effects take years to develop
   i. multifactorial diseases although influenced by other factors as inborn predisposition stress, environmental substances and exercise, as well as nutritions, take years to develop
   ii. nutrition is only one part of the development and treatment of multifactorial diseases like heart disease, cancer and hypertension

7. Studies
   a. epidemiological studies observe disease occurance and lifestyles feature of populations
      i. epidemiological studies identify apparent relationships between lifestyle factors
         example: hypertension is practically nonexistent for mainland Chinese while Chinese Americans have the same percentage of hypertension as their Caucasian neighbors
      ii. they do not specify causes of coexisting conditions
      iii. help raise questions to guide future research
   b. metabolic studies control levels of nutrients of food substances and observe effects in humans or animals
      i. in animals only the nutritients being studied are allowed to change, and changes in body chemistry or excreted substances can be measured
         example: saccharin, red dye II, nutrasweet
      ii. animal studies have advantages over human studies
         example: shorter life spans, controlled diets, extreme variations can be tested-animals can be killed for exacting study
   c. single food studies are meaningless because no single food meets all of the nutritional needs of animals or humans
   d. human metabolic studies (clinical) can usually only examine blood, urine, feces and some physical measures like blood pressure — Nutrition and Elementary Food Science, Marks
      i. scope, number of subjects and duration of human studies may vary widely
      ii. conditions of study can affect results
      iii. placebos are used in blind studies

e. personal testimony (anecdotal reporting and celebrity promotion) is not scientifically valid

8. Good nutritional studies require careful work and reporting
   a. designing, funding, operating, analyzing and publishing are all critical
   b. researchers qualifications are important and lend credibility to study
   c. results should be published in respected journals
   d. validity of finding increase as similar studies reproduce similar results

IV. Study Vocabulary (Suggested)
   A. Nutrients
   B. Elements
   C. Malconutrients
   D. Micronutrients
   E. Kilocalorie
   F. Metabolism
   G. Malnutrition
   H. Placebo
   I. Lipids

V. Student Exercise — Teacher made
   A. Short written report on relevant nutritional study
   B. Oral report
   C. Sectional homework
   D. Post-test

VI. Outcomes
   A. Understand the need for a chemical balance in the human body
   B. Understand the role nutrients play in body development
   C. Understand how and why standards are set
   D. Develop critical thinking skills when reading nutritional studies

VII. Resources
   A. Nutrition Basics: 20 overhead transparencies
   B. Comparison Cards: 72 cards with nutrient profiles of foods
   C. Food Models: actual size plastic models of food to teach portion control
   D. The New Nutrition: video or film strips focusing on what nutrition means to teenagers
   E. Read the Label, Set a Better Table: video

RATING YOURSELF NUTRITIONALLY
BEHAVIORAL OBJECTIVE - The Student will know the significances of intakes above and below recommended levels, methods of measuring, evaluating the diet and ways to estimate adequacy of an individual's nutrient intake.
MEASUREMENT: Oral and written test, individual diet analysis, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objectives (Specific) A. Student will understand effects of long term and short term over and under nutrition B. Students will be able to state pros and cons of blood test, urine test, feeling of well being, skinfold measurement, and appearance judgments as indicators of nutrition adequacy C. Students will utilize basic principles of using food composition tables and food group plans to estimate diet adequacy D. Students will be able to understand the principles included in: the basic four food guide, hassle-free guide to a better diet, modified basic four exchange lists for meal guidelines for Americans, healthy people: The Surgeon General's Report on Health Promotion, and disease prevention towards healthful diets and basic food guide E. Students will be able to analyze individual intake using the basic food guide	
II. Pre-test	Teacher made
III. Content A. Nutrient assessment techniques 1. nutrition status rating techniques 2. consequences of nutrient intake above or below actual needs	Nutrition for Living Pgs. 24-42
B. Body response to varying nutrient levels 1. short term over or under consumption is not dangerous 2. long term over consumption of a nutrient can cause harm a. water-soluble nutrients are stored in small amounts i. moderate excesses of water-soluble nutrients are usually excreted in urine ii. large excesses can be harmful, as for vitamin B6 b. fat-soluble vitamins A and D can accumulate to high levels and cause permanant damage	

C. Body based measures of nutrition status have limitations
   1. biochemical test of blood and urine are most accurate
   2. anthropometric body measure is next most accurate
   3. appearance and sense of well being is the least accurate
   4. blood test shows levels of nutrient and metabolites circulating in the blood but not necessarily in other tissue
      a. abnormal blood levels can be a sign of dietary problems, illness or recent consumption patterns
      b. blood tests are used to diagnose and monitor diseases
   5. urine tests show nutrient and metabolete levels for comparison against normal standards
   6. height and weight are rough measures of past nutrient intake
      a. height shows genetic growth potential and related to nutrition, adequacy during growth
      b. in children, height and weight are rough indicators of energy intake in relationship to output
      c. in adults, weight changes show variation in water, body fat (kcalorie balance) and/or muscle mass
      d. height/weight tables are used as standards
   7. skinfold measurements show the thickness of skin and fat beneath it — Diet for Sport Smith, N. 1976
      a. thickened fat layers are a sign of excess energy intake
      b. thinner fat layers show long term energy deficits
      c. trained individuals using calipers can measure skin folds at several body sites
      d. body fat percentages are derived from conversion tables
   8. appearance changes are inexact indicators of nutrition status
      a. elderly, alcoholics, chronic illness and people from developing countries may have external signs of malnutrition
      b. specific tests utilized in appearance change may suggest malnutrition
   9. person's feeling of well being may be related to a nutritional condition
      a. consult medical professional
      b. specific test for symptoms

10. hair analysis is unreliable measurement of nutritional condition — Journal of the American Medical Association 254: 1041-1045
    a. laboratories are often inconsistent
    b. hair composition may change due to shampoos, bleach, dyes, chemicals and water
    c. hair composition does not always reflect nutrient levels in body
    d. hair analysis is valid for:
        i. identifying some types of mineral poisoning
        ii. comparing mineral status of population groups

D. Diet analysis is more useful than body measurement for estimating nutritional status
    1. twenty-four hour consumption recall
        a. typical day
        b. important details of what has been eaten
        c. serving size
    2. food records allow individuals exact calculation of what has been consumed
        a. food intake may be modified when records are kept
        b. several days are needed to obtain an accurate estimate

E. Methods used to examine diet records
    1. food composition tables from the U.S. Department of Agriculture are based on laboratory analysis of food
        a. analyze diet, record nutrient intake, nutrient totals, look up RDA, calculate RDA percentage for nutrient sum
            i. 70% RDA is permissable for healthy individuals
            ii. consuming more than 100% of RDA has no advantages
        b. computers can speed calculation
            i. quality software may not be available
            ii. accurate intake information is critical
    2. food group plans are faster and more convenient in calculating nutrient intake
        a. foods with similar nutrient levels are grouped together — U.S. Department of Agriculture
        b. basic four food groups is an easy system to implement
            i. eating minimum recommended number of servings from each group daily will allow adequate nutrient intake
            ii. eating a variety of foods within each group is emphasized
            iii. foods within the group may vary in nutrient density

iv. low nutrient density foods/beverages are not included in the basic four plan	
v. no adjustments are made for foods with high fat or added sugar	
vi. plan assumes the intake of meat and dairy products	
c. hassle-free guide to a better diet	U.S. Department of Agriculture
i. addition food groups	
ii. limited due to high levels of fats, sugar and/or alcohol	
d. modified basic four allows for consistent nutrient intake for adult males (2200 kcalories per day)	King at U. C. Berkeley
e. exchange list for meal planning--list of foods interchangeable for carbohydrates protein, fat and kcalorie levels	American Dietetic Association
f. Dietary Goals for the U.S. (1977) Senate select committee on nutrition recommendations for fats, refined sugar, cholesterol, salt and kcalories	
g. healthy people: Surgeon General's Report on Health Promotion and Disease Prevention (1979) similar to Dietary Goals for the U.S. but with different conclusions regarding restriction of sugars and fats	
h. Nutrition and Your Health; Dietary Guidelines for Americans (1980-revised 1985)	
i. eat variety of foods	
ii. maintain desirable weight	
iii. avoid fat, saturated fat and cholesterol	
iv. eat food with starch and fiber	
v. avoid excess sugar intake	
vi. avoid excess sodium intake	
vii. moderation in alcoholic intake	
i. Basic Food Guide is expansion of the basic four food guide and the Hassle-Free Guide	Christian and Greger
i. milk products group recommended by age	
ii. fruits and vegetables group to include four minimum servings with one source of vitamin A and one source of vitamin C	
iii. whole grains are encouraged, enriched grain products are allowed; refined and unenriched products do not count	
iv. serving of meat and meat alternates (two daily) should include some plant sources each week	
v. serving sizes are specified; e.g., 1 cup milk, 2-3 oz.; lean meat; 1/2 c. canned fruit; 1 slice bread	
vi. rulers show which foods are high in added sugar, salt and fat	

vii. combination foods must be separated into main food components

viii. limited extras are not in the basic food groups because of their low nutrient density

j. Basic Food Guide is used to evaluate diet — Christian and Greger

i. record food intake, serving size per group, calculate totals and compare minimum four food group standards

ii. consistent intake below minimum standards means nutrient level is below standard

iii. intakes above standard is not necessarily a problem unless kcalorie consumption is high

IV. Study vocabulary (Suggested)
- A. Biochemical test
- B. Anthropometric test
- C. Nutrient density

V. Student exercise
- A. Student perpare individual diet evaluation
- B. Oral report
- C. Sectional homework
- D. Post-test

VI. Outcomes
- A. Understand testing procedures, biochemical and anthropometric
- B. Understand use of diet analysis
- C. Understand and be able to work with Food Group Plans
- D. Understand the Basic Food Guide and its relationship to Basic Four and Hassle-Free Guides

VII. Resources
- A. Dietary Guidelines for Americans: 18-minute slide tape kit
- B. West Dietary Analysis Program for Apple IIe computers
- C. Nutrition & Women's Health

UNIT 3

PHYSIOLOGY OF NUTRITION
BEHAVIORAL OBJECTIVE - The student will know the processes involved in digesting and food absorption in order to obtain body needed nutrients. The student will know the mechanism by which nutrients are delivered to the cells, used for cellular function, and removal from the body.
MEASUREMENT: Oral written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objectives (Specific) A. To understand basic characteristics of digestive system B. To be able to list and describe major parts of the cell C. To be able to outline elementary metabolism process D. To be able to trace nutrient movement into and out of cells via the circulatory and lymphatic systems E. To be able to describe major components and functions of the excretory system	
II. Pre-test	Teacher made
III. Content A. Processes and structures for incorporating food into the body 1. process includes: a. digestion b. absorption c. circulation d. metabolism 2. cell ultimate user of all nutrients	Nutrition for Living Pgs. 44-61
B. Digestion prepares nutrients for absorption 1. features of digestive tract a. alementary canal (gastrointestinal or G.I. tract) long hollow tube from mouth to anus b. lining (mucosa) skin like material separates the material inside tract from the inside of body c. particle size is a factor that determines whether a substance can be absorbed d. longitudinal and circular muscle behind mucosa control the content movement in the G.I. tract i. sphincter is a circular muscle that opens and closes sections of the G.I. tract ii. the anal sphincter is controlled voluntarily while the others are regulated by automatic signals within the nervous system e. approximately two gallons of various digestive fluids are secreted into G.I. tract daily i. mucus keeps lining (mucosa) moist, slippery, and protects lining from effects	Textbook of Medical Physiology Guyton A.C. 1981

of other secretions
ii. some secretions control acidity of G.I. tract content
iii. enzymes are protein that help break down food by speeding up the biochemical reaction of digestion
iv. hormones are chemical messengers produced in one region of the body that affect processes in other body regions

f. one to three days elapse between eating food and removing its waste from the body
g. cells in the mucosa (lining) are replaced every two to three days

2. digestion and absorption occur in a sequence of steps
a. the first phase is called cephalic; it involves:
i. thinking about food
ii. reacting to sensory food association
b. food is chewed and mixed with saliva in the mouth
i. saliva moistens and lubricates the food
ii. rinse teeth to help prevent tooth decay
iii. amylase enzymes in saliva start break down of starch in foods
iv. body produces approximately a quart of saliva per day
c. swallowing takes place in the pharynx (common pathway for food and air)
d. between pharynx and stomach the esophagus moves food by peristalsis (series of involuntary rhythmic muscle contractions)
i. sphincter at the bottom of the esophagus opens to let food into the stomach and closes to keep food and digestive juices from getting back into the esophagus
ii. heart burn is an irritation of the esophagus that occurs when the sphincter does not function properly
iii. sphincter must open for vomiting to occur
e. the stomach holds approximately one to two quarts of food and liquid
i. the stomach acts as a reservoir, mixer to produce chyme, secretor of acid and enzymes that digest protein
ii. emotion and the presence of food in the stomach affect rate of stomach secretions
iii. stomach does not digest itself with its own secretion because of the material its made of, cell formation and coating of mucus

iv. peptic ulcer occurs when stomach or small intestine lining is worn away by failure of protective mechanism and is worsened by irritants such as alcohol, caffeine and tobacco

v. water, alcohol, and some drugs are absorbed in the stomach

vi. stomach emptying takes several hours and is affected by food present (liquids faster than solids, carbohydrates and proteins faster than fats, small volumes faster than large ones)

vii. hormones from small intestine affect rate of secretion of chyme from stomach and hormones are affected by emotion

f. breakdown of carbohydrates, proteins, and fats into small units and absorption of these small units plus water, vitamins, minerals and alcohol occur mainly in small intestine

i. secretions include digestive enzymes from lining of small intestine, bile from the liver by way of the gall bladder for fat emulsion and pancreas secretions of alkali and enzymes to digest fat, protein and carbohydrates

ii. villi of the small intestine lining provide a large surface for absorption of nutrients to take place

a^1 microvilli on the surface of the villi extend absorptive surface

a^2 villi and microvilli increase surface area approximately 600 times

a^3 over 90% of protein, carbohydrates and fats are digested and absorbed by the time food completes its passage through the small intestine

g. the large intestine serves as a collection chamber for solid waste coming from the small intestine, a tank for bacterial growth producing vitamins and absorbable energy source, and as a place for the absorption of water, sodium and chloride — McNeil 1984 American Journal of Clinical Nutrition 39: 338-342

i. diarrhea occurs when the large intestine fails to absorb sufficient water from its contents — Lacey & Gibson 1985 Human Nutrition Applied Nutrition 39A: 36-42

ii. laxatives cause the colon to empty faster

C. Cell is the smallest and simplest unit of living matter and the site of basic life processes such as the release of energy from nutrients — Basic Human Anatomy Spence 1982

1. animal and plant cells contain:
    a. permeable membrane that control entry and exit of substances
    b. fluid-like cytoplasm
    c. nucleus with genetic information
    d. nutochondria of energy production
    e. endoplasmic reticular with channels where protein and fats are synthesized
    f. subcellular sections where syntheses, storage and breakdowns occur
2. spaces between cells are occupied by interstitial fluid
3. tissues are groups of cells that perform different functions
    a. muscular
    b. nervous
    c. connective
    d. eptlhelia
4. organs are combinations of several types of tissue that perform complex processes
5. systems involve more than one organ in a major body process
6. a total organism is a complex combination of systems

D. Metabolism is a collection of processes that take place within the cells of the body to sustain life
1. metabolism requires a regular supply of nutrients
2. new substances are put together in an aspect of metabolism called synthesis, and breakdown reactions occur at the same time but at different rates
3. synthesis reactions are dominant in periods of growth, while breakdown reactions are more dominant in illness or injury

E. Nutrients and oxygen that cells need, cellular products active in other cells, and waste products produced by metabolism are all transported in the circulatory system
1. the circulatory system is a closed, continuous network of blood vessels in which blood circulates repeatedly throughout the body
2. one side of the heart pushes the blood through the lungs in the pulmonary circuit of the circulatory system, and the other side of the heart provides power to propel blood through the systemic circuit that serves the rest of the body
    a. in the pulmonary circuit, the blood moves from the right side of the heart to the lungs where carbon dioxide is released and oxygen is taken up and then returns to the heart

b. when the blood returns to the left side of the heart, it is pumped through the systemic circuit where oxygen and nutrients are released to the cells
c. carbon dioxide and other products of metabolism enter the blood before the blood is returned to the right side of the heart to complete the cycle

3. arteries are large vessels near the heart; smaller vessels called arterioles branch off from the arteries and capillaries and tiny vessels where substances are exchanged between the blood and the cell; the blood returns to the heart through small venules that converge to form large veins
4. nutrients enter the blood through the small intestine and are processed in the liver
   a. in the small intestine water and soluble nutrients enter the blood through the capillaries
   b. prior to the blood returning to the heart from the liver, nutrients are stored, prepared for metabolic processes, or left unchanged
   c. after leaving the liver, the venous blood mixes with the blood returning to the heart from other areas of the body
5. nutrients that pass from the blood to the cells must pass through the capillary walls into the the interstital fluid, then through the cell membrane; this whole process is reversed for metabolic products of the cells that pass into the blood stream
6. blood proportion in the various parts of the body can be changed according to needs
   a. at rest, half of the blood is pumped to the abdomen, one fourth to the muscle, remaining fourth to the heart, brain and skin
   b. during strenuous exercise, up to seven-eighths of the blood goes to the muscle and blood flow to the skin increases
   c. after eating a large meal, extra blood is diverted to the intestine

F. The lymphatic system is a one way system of vessels that empty into major veins of the circulatory system
   a. lymph is a clear fluid that originates from the interstital fluid
   b. in the small intestine, fatty products of digestion enter the lymph by way of lacteal

G. Feces, urine, perspiration and exhaled vapors are used to remove waste from the body

Mirkin, Hoffman 1978
Sports Medicine Book

1. feces contain solid waste from the digestive system along with some water, plant fiber and bacteria
2. urine contains water and dissolved substances
   a. in the nephrons of the kidneys waste products are filtered out of the blood
   b. hormones control the amount of water and dissolved substances that are reabsorbed before urine leaves kidneys
3. water and some minerals (salts) leave the body in perspiration
4. carbon dioxide and some water are exhaled through the lungs
   a. amounts increase in periods of rapid breathing
   b. exercise and high altitude increase the breathing rate

IV. Study Vocabulary (Suggested)

A. Mucosa
B. Musus
C. Enzymes
D. Hormones
E. Cephalic
F. Pharynx
G. Esophagus
H. Chyme
I. Arteries
J. Lumen
K. Caffeine
L. Bile
M. Villi
N. Microvilli
O. Diarrhea
P. Colon
Q. Cytoplasm
R. Mitochondria
S. Endoplasmic
T. Interstitial fluid
U. Capillaries
V. Lacteals

V. Student Exercises

A. Develop a labelled diagram of one of the following:
   1. cell
   2. circulatory system
   3. villi and blood vessels
   4. lymphatic system
B. Oral report. Examples:
   1. laxative abuse
   2. anorexia
   3. obesity
C. Sectional homework
D. Post-test

VI. Outcomes

A. Student will be able to explain the basic characteristics of the digestive system
B. List and describe major parts of the cell
C. Understand elementary processes of metabolism
D. Trace paths of nutrient movement into and out of cells by way of the circulatory system and lymphatic system
E. Describe major components and functions of the excretory system

VII. Resources

A. Anatomy & Physiology: 40 slides and cassette
B. Diseases of the Digestive System: slides and cassette
C. Metabolism: The Fire of Life: filmstrip

UNIT 4

WATER: NOT TO BE TAKEN FOR GRANTED
BEHAVIORAL OBJECTIVE – The Student will know water as a nutrient is crucial for survival. Water is necessary as a solvent participant in the metabolic reaction, a medium for P.H. control, a transporter of nutrients, a lubricant, and a body temperature regulator.
MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. Demonstrate the importance of water as an essential nutrient B. List routes through which water may be lost from the body C. Name sources of water for the body D. State conditions under which thirst may or may not be a reliable indicator of water intake need E. Explain major function of water in the body F. Describe the principles of osmosis G. State consequence of overcomsumption of water	
II. Pre-test	Teacher made
III. Content A. Water is crucial for survival 1. water deprivation can, after a few days, result in death 2. hydration is a term referring to the presence of water	Nutrition for Living pgs. 66-82
B. Water is the largest constituent of the body 1. adult male body weight is composed of approximately 60% water a. all tissue contains water; content varies in different tissues b. muscle contains approximately 75% water, bones about 25% water, fat 20 to 33% water, and teeth only 10% 2. all people vary as to percentage of body water a. women's bodies contain more fat than men's bodies, so they are more likely to have less than 60% total body water b. infants start with more than 60% total body content but decrease as cells mature in the first year c. elderly have less body water as the proportion of fat increases	Textbook of Medical Physiology Guyton, A.C. 1981
C. Water loss may cause severe consequence 1. body water loss from 1% to 10-12% may cause: a. thirst and discomfort b. kidney failure and circulatory collapse c. death	

2. physical impairment occurs at approximately 3% body water loss
3. body water loss of approximately 4% of body weight decreases strength as much as 30%
4. body water loss includes:
    a. loss of appetite
    b. sense of oppression
    c. decrease of blood and urine volume
    d. dry mouth
    e. defective temperature regulation
    f. difficulty in performing physical work
    g. flushed skin
    h. emotional changes
    i. increased heart and breathing rates
    j. dizziness
    k. slurred speech
    l. weakness
    m. confusion
    n. loss of muscle control
    o. tongue swelling
    p. inability to balance

D. Body normally puts out 2-3 liters of water a day
1. urine makes up for 50% of normal water loss
2. other bodily water losses:
    a. evaporation -insensible losses
    b. water vapor loss through lungs--amounts vary with changes in environmental conditions
    c. sweating-labor and heat
    d. water in feces
    e. diuretics (including alcohol and caffeine) increase a water loss through urine (also can be accomplished by drinking large amounts of water-approximately 8 glasses per day)

E. Water is available to the body from beverages, food and metabolic reactions within the body

Nutrition and Athletic Performance Greenleaf, J.E. 1982

1. 50% of the 2-3 liters the body consumes comes from beverages
2. approximately 35% comes from solid foods
3. approximately 15% comes from the metabolic reactions occuring within the body
4. proportions vary from person to person and the intake of beverages and solid foods

F. Evaluation of water intake adequate
1. water or fluid intake to satisfy thirst is usually adequate
    a. thirst causes fluid replacement prior to 1% body weight loss
    b. illness or periods of heavy sweating may affect thirst mechanism

2. normal adult guideline is to consume 1 liter of fluids for each 1000 kcalories expended
   a. infants need 1.5 liters per 1000 kcalories expended
   b. dieters should consider energy expended, not consumed
   c. guidelines do not apply to illness or heavy exercise
3. normal urine output is 2 or more cups per day
   a. athletes should excrete 3½ cups of urine daily
   b. people who excrete less than the 2 cups of urine per day make it more difficult for their kidneys to remove metabolic waste
4. each pound of weight loss needs 2 cups of fluid to replace loss
   a. weight loss during strenuous exercise is water, not fat
   b. drinking according to thirst may require 3 days to replace water loss from heavy sweating
   c. ignoring fluid replacement may result in dehydration and even death

G. Extra water intake during exercise helps avoid dehydration — Inside Running Costill D. L. 1986
1. heavy exercise causes the loss of more water than the stomach can handle to replace
2. to lessen dehydration:
   a. drink 2-3 cups of water 2 hours before activity
   b. drink 2 cups of cold water 10-15 minutes before activity
   c. Drink ½ to 1 cup every 10-15 minutes during the activity
3. cold water (40-50 F) is best before and during heavy exercise
   a. leaves stomach faster than warm water
   b. leaves faster than beverages containing sugar
4. stomach cramps occur when intake is over the recommended levels

H. Functions of water in body:
1. major component of all cells and necessary to fill out tissue structure — Nutrition, Physical Fitness and Health Vol. 7 Saltin B. 1978
2. water is solvent in which most biochemical reactions take place
   a. body fluids usually consist of a water based solvent that contains dissolved solvents
   b. water distribution between body cells is influenced by electrolytes (particles that carry electrical charge in solution- electrolyte inbalance may cause death)

c. blood and lymph pH is usually 7.4
   i. at neutral pH7 the number of positive and negative ions are the same as in plain water with equal H+ and OH-ions
   ii. body buffer system maintains blood and lymph at a slightly alkaline pH

3. biochemical reactions, such as hydrolysis include water as a participating chemical
   a. in hydrolysis a water molecule splits to form an OH-ion and a H+ion
   b. the splitting of a water molecule is part of the process that breaks down carbohydrates, fat, and protein molecules
4. blood, lymph, urine and gastrointestinal secretions are water containing body fluids that transport substances (nutrients, waste products and/or enzymes) in the body
5. saliva in the GI tract, tears in the eyes and synovial fluid in the joints are lubricating fluids that have water bases
6. the body uses water to control its temperature at about 98.6 degrees Fahrenheit
   a. blood flow is diverted to the skin to cool the body
   b. blood flow is diverted to inside the body to conserve heat
   c. evaporation of 1 liter of water in perspiration takes away 600 kcalories of body heat

I. Water distribution within the body is important for normal functions
1. 80% of water in GI tract is absorbed in the small intestines, a small fraction of water is absorbed in the stomach, the rest (15 to 20%) is absorbed in the colon
   a. 100 ml of water (½ cup) is excreted daily in the feces
   b. diarrhea causes water to be lost in the feces and may lead to dehydration
2. body fluids (42 liters) are divided into intracellular and extracellular apartments
   a. 60% (25 liters) is inside the cell
   b. 40% (17 liters) is outside the cell, in the blood and extracellular fluids
   c. 70% of the total body water (3 liters) is in blood plasma
   d. 33% (14 liters) is in other extracellular fluids
3. Changes in water balance between intracellular and extracellular fluids are dangerous
   a. as amount of intracellular fluid decreases, metabolic reactions become less efficient

Journal of Sports Medicine and Physical Fitness 19: 1-9

b. as amount of extracellular fluid decreases, blood volume decreases
   i. less oxygen is delivered to cells
   ii. body temperature rises
   iii. body system functions are disturbed

4. fluid volumes are determined by movement of water and particles through selectively permeable membranes
   a. osmosis, solvents such as water move through membranes when the concentration of particles on one side is higher than on the other
   b. protein does not pass through membrane and helps to maintain intracellular volume
   c. potassium and sodium concentration are the main positively-charged ions that cause fluid shifts into and out of cells
      i. potassium is mostly inside the cells and sodium is mostly outside the cells
      ii. the sodium-potassium pump in cell membranes moves potassium into cells and takes sodium out of the cells
   d. other ions contribute to the total osmotic balance
      i. chloride and bicarbonate ions are negative ions that are mostly outside the cells
      ii. potassium magnesium ions and negative ions containing sulfur and phosphorous are mostly inside the cells
   e. when levels of dissolved substances in the body get too high, the kidneys allow the excess to leave the body in the urine
      i. excretion of excess solutes requires adequate water for urine formation
      ii. in sweating, since more water that solutes is lost, interstitial fluid volume becomes more concentrated, causing water to be drawn from the blood and cells to restore balance in concentrations.
      iii. it may take hours to restore water and electrolyte concentrations after heavy sweating

J. Drinking toxic amount of water is rare
   1. after six or more hours of continuous activity, marathon runners who drink very large volumes of water (20 liters or more) can become ill with water intoxication
   2. body can tolerate intakes of 9½ liters per day

IV. Study vocabulary (Suggested)
- A. Hydration
- B. Diuretics
- C. Dehydration
- D. Molecule
- E. Gastrointestinal
- F. Synovial
- G. Intracellular
- H. Extracellular
- I. Permeable membrane
- J. Osmosis
- K. Potassium
- L. Sodium
- M. Chloride
- N. Bicarbonate
- O. Sulfur
- P. Phosphorus
- Q. Solutes
- R. Hydrolysis

V. Student Exercise
- A. Develop a chart of selected foods and show percentages of water
- B. Develop a model showing the osmosis concept
- C. Develop a water concept map
- D. Short written report on the problem of water loss and replacement for athletes
- E. Sectional homework
- F. Chapter test

VI. Outcomes
- A. The student should be able to understand the effects of water depletion and sources of water intake
- B. The student should know the functions of water as a solvent, participant in metabolic reactions, medium for pH control, transporter of nutrients, a lubricant, and regulator of body temperature
- C. The student should know water balance as a feature of cellular levels

VII. Resources
- A. Nutrition, Metabolism, Fluid, and Electrolyte Balance: filmstrip
- B. Nutrition for Teen Athletes: 13-minute slide cassette
- C. Nutritionist III: computer program for IBM PCs; fitness sub-program
- D. Nutrition & Exercise: media kit

CARBOHYDRATES

BEHAVIORAL OBJECTIVE - The Student will know the carbohydrates present in foods and the body and their function as well as various sugars, starches and fibers. Student will know how carbohydrates are digested and absorbed in the gastrointestinal system and their role in disease control.

MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. Distinguish among sugars, starches and fibers as to source, characteristics, and function B. Give examples of monosaccharides, disaccharides, and polysaccharides C. Define fiber and understand its function D. List the site of digestion and the process of absorption for monosaccharides, disaccharides, and polysaccharides E. Cite examples of nonabsorption of carbohydrates and problems attributed to nonabsorption F. Understand the process of regulating glucose and glycogen levels G. Understand differences of insulin-dependent diabetes, noninsulin dependent diabetes and reactive hypoglycemia H. List diseases which are affected by carbohydrates in the diet I. Assess individual carbohydrate and fiber intake using standard guides	
II. Pre-test	Teacher made
III. Content A. Dietary carbohydrate misconception and evaluative techniques	Nutrition for Living Pgs. 110-136
B. There are four major functions for carbohydrates in the body 1. sugars, starches and dextrins provide energy a. these are available carbohydrates because they can be hydrolyzed by digestive enzymes and absorbed in the small intestine b. although fiber is a form of carbohydrate, it provides only a small amount of energy after breakdown by bacteria in the colon 2. carbohydrates spare protein by providing energy 3. small amounts of carbohydrates participate in the metabolism of body fat 4. fiber provides bulk that keeps intestinal muscles in proper condition	

C. Carbohydrates occur mainly in plant foods and milk — Contemporary Nutrition Andersen, J.W. & Clark, J.T. 1986

1. glucose, fructose, sucrose, lactose and maltose are the major sugars
   a. glucose and fructose are monosaccharides; sucrose, maltose and lactose are disaccharides
      i. simple sugars are water-soluble and vary in sweetness levels
      ii. glucose is an important sugar in all plants and animals
      iii. monosaccharides contain five or six carbon atoms with H (hydrogen) and OH (hydroxyl) groups attached
         a 1) all carbohydrates contain the carbon, hydrogen and oxygen atoms in the same ratio as if there were one water molecule for each carbon atom
         a 2) sugars and all other substances that contain carbon are organic substances
      iv. disaccharides have two monosaccharides linked together
   b. green plants use sunlight, carbon dioxide and water to produce glucose by photosynthesis
      i. oxygen is a by-product of photosynthesis
      ii. some of the glucose is converted to fructose and other monosaccharides
      iii. disaccharides are produced by linking monosaccharides together in plant cells
         b 1) maltose contains two glucose units
         b 2) sucrose has a glucose and a fructose unit
         b 3) lactose is produced in animal milks by linking a glucose unit with a galactose unit
      iv. fruits usually have more sugar than other plant parts, and sugar cane and sugar beets are usually high in sugars
   c. sugars are often added to foods during processing
      i. sucrose, grain-derived sweeteners (sweet syrups, glucose, and fructose), and lactose from whey are most commonly used
      ii. mannitol and sorbitol are sugar alcohols used in sugarless gum and some candies
      iii. other sugars used as food ingredients are turbinado sugar and total invert sugar
      iv. the body uses manufactured sugar products the same way it uses sugars that occur naturally in foods
      v. check ingredient labels to see roughly how much sugar is added to foods
      vi. Americans consume an average of 68 pounds of refined sugar each year and 58 pounds of corn sweeteners

d. starches and dextrins are not as soluble or sweet as sugars
   i. they contain dozens of glucose units linked together in long chains
   ii. they are also called complex carbohydrates and are available polysaccharides
   iii. starches are found in seeds, roots, tubers, grains, nuts, legumes, root vegetables and potatoes
   iv. dry heat converts some of the starch in food to dextrins (shorter chains of glucose units linked together)
   d) further breakdown of starch produces malted starches
   d) modified starches have greater thickening capacity

2. Fiber is a plant food component that humans cannot digest
   a. fiber is like starch with long chains of glucose but the links are in forms that our digestive enzymes cannot break apart
   b. cellulose and hemicellulose are insoluble fibers in cell walls of plants
      i. they are prevalent in bran, seeds, and peels
      ii. insoluble fiber accounts for 3/4 of total unavailable carbohydrates in food
      iii. insoluble fiber can speed the movement of materials through the lower part of the GI tract
   c. pectins and gums are soluble forms of fiber that can delay stomach emptying
   d. fiber is often removed in food processing; e.g., white bread and applesauce
   e. fiber is sometimes added to processed foods; e.g., cellulose in some breads, and pectins and gums as stabilizers or thickeners
   f. polydextrose is a new fiber-like additive yielding 1 kcalorie per gram for reduced kcalorie foods

3. dietary fiber is a specific term referring to indigestible plant materials
   a. edible fiber and unavailable carbohydrates are other terms for dietary fiber
   b. dietary fiber is hard to measure because of the different types of food fiber and the difficulty of testing them
   c. crude fiber underestimates dietary fiber

D. Carbohydrate digestion occurs in several regions of the GI tract

1. monosaccharides can be absorbed whole in the small intestine
2. disaccharides are hydrolyzed to monosaccharides disaccharidases and then absorbed in the small intestine
3. starches and dextrins are partly digested by amylase enzymes in saliva and mainly digested in the small intestine
   a. amylase enzymes from the pancreas break down the large molecules to disaccharides
   b. disaccharidases in the small intestine break down disaccharides to monosaccharides that can be absorbed
4. although fiber cannot be digested by human enzymes, bacteria in the colon can break some of the fiber's bonds and form products that the body can absorb, thus providing some energy
5. if carbohydrates enter the colon undigested, they can be digested by bacteria (resulting in gas production) and draw water into the lumen of the intestine (resulting in diarrhea)
   a. lactose intolerance is caused by an inadequate level of lactase enzyme in the intestine
      i. this condition is also known as lactase insufficiency or lactase nonpersistence
      ii. the level of lactase in the intestine declines as people get older, especially for people with African, Asian, or Mediterranean ancestry
      iii. cramping and diarrhea are less of a problem when the stomach empties slowly, so solid foods and fat can decrease the possibility
      iv. some people tolerate yogurt better than milk, perhaps because the live bacterial cultures in yogurt hydrolyze part of the lactose
      v. to enhance lactose digestion, lactase enzyme powders can be added to milk products or lactase enzyme tablets can be taken with a meal
      vi. hard cheeses and special low-lactose products are available to provide the nutrients of milk with low levels of lactose
   b. sugar alcohols, because they are absorbed slowly, can cause cramps and diarrhea when they reach the large intestine
   c. athletes who consume sugary food before their activities can experience diarrhea and thus increase the likelihood of dehydration

American Journal of Clinical Nutrition
Cummings, Hill, Jenkins, Pearson Wiggins
1976 29: 1468

E. Liver activities, hormones, and exercise influence carbohydrate utilization — Textbook of Medical Physiology Guyton, A.C.

1. the monosaccharides glucose and fructose are the main carbohydrates absorbed via intestinal cells
   a. during absorption, part of the fructose is converted to glucose as it passes through the intestinal cell; most of the remaining fructose is converted to glucose in the liver
   b. after absorption, some of the blood glucose is used for energy, and some remains in the bloodstream, but the majority is converted to fat and glycogen for storage of energy
2. the liver helps monitor the level of blood glucose
   a. excess glucose is removed by converting it to molecules that are further converted to fat and glycogen
   b. when blood glucose levels fall, the liver converts glycogen to glucose
3. insulin and glucagon are the main hormones active in regulation of blood glucose
   a. insulin from the pancreas causes cells to remove glucose from the blood, triggers the liver and muscles to convert glucose to glycogen, and promotes fat formation by liver and fat cells
   b. insulin promotes protein synthesis and hinders the breakdown of fat
   c. glucagon from the pancreas promotes glucose production by increasing the utilization of glycogen and promoting breakdown of fat stores, thus opposing the activities of insulin
   d. insulin is produced when blood glucose levels rise after eating, and glucagon is produced when blood glucose levels fall after fasting
   e. other hormones, such as epinephrine from the adrenal glands, also help mobilize energy stores
4. although insulin production decreases during exercise, the muscles take in more glucose from the blood to produce energy — Inside Running Costil, D.L. 1986
   a. consuming sugar before exercise causes a temporary increase in insulin production that can interfere with utilization of glucose and fat for energy, thus speeding the onset of exhaustion
   b. to avoid premature exhaustion, do not consume carbohydrates any later than 1-1/2 hours before vigorous exercise

c. taking in carbohydrates during an event may be beneficial for periods of activity lasting more than 1-1/2 hours
   i. too much sugar can slow down water absorption
   ii. glucose polymers interfere less with water absorption
d. glycogen loading increases stores of glycogen in muscles to increase the time it takes for exhaustion to occur
   i. one week before a race, exercise levels are reduced and the diet remains normal
   ii. 2 to 4 days before an event, limited exercise is performed and carbohydrate intake is raised to about 70% of kcalories
   iii. glycogen loading causes extra water to be retained
   iv. check with a physician before trying glycogen loading

5. Abnormal insulin production or effectiveness can occur in diabetics
   a. in insulin-dependent diabetes, too little insulin is produced in the pancreas, so sugar builds up in the blood
      i. diets high in complex carbohydrates and soluble fiber help diabetics control their blood sugar
      ii. eating sugar doesn't cause diabetes
   b. non-insulin-dependent diabetes occurs frequently in overweight adults whose cells do not respond properly to insulin
      i. this is treated with weight reduction, drugs, or a diet high in soluble dietary fiber
      ii. genetic inheritance influences development of both types of diabetes
   c. reactive hypoglycemia occurs when too much insulin is produced after eating carbohydrates

F. Carbohydrates play a role in some diseases
1. overweight people are too fat because they have consumed excess kcalories regardless of the source
2. dental caries occur when acids destroy tooth enamel
   a. fluoride and low susceptibility make some people less likely to develop dental caries
   b. sucrose, glucose, fructose, maltose, and lactose are fermentable sugars that feed mouth bacteria, causing acid levels to rise
   c. sugar alcohols are not cariogenic
   d. eating foods with sticky sugars and eating them frequently between meals increase the mouth's acid production

Nutrition Forum
Rovin, S. 1984
1: 22-23

e. saliva washes sugar off teeth and promotes remineralization
f. fats and phosphorus in foods are protective
g. the American Dental Association recommends a nutritious diet with few sweet snacks, careful hygiene, and regular dental check-ups

3. some people eat too much sugar
   a. refined carbohydrates like sugar and unenriched flour have few nutrients
   b. consumption of low-nutrient-density foods should not exceed 20% of kcalories for people who are not highly active
   c. minimal processing is no guarantee of high-nutrient density
   d. too much dietary fiber in some foods such as whole grains can interfere with mineral absorption
4. adequate fiber relieves constipation
   a. fiber absorbs water and makes feces bulkier
   b. bulky feces exercise colon muscles and move through the colon more easily
   c. a transit time of 24-72 hours is normal with adequate fiber
5. diets with adequate fiber help relieve diverticular disease
   a. 1/3 of people over 60 have diverticular disease with outpouchings in the colon wall
   b. high-fiber diets decrease pressure in the colon
6. dietary fiber may provide protection against colon cancer
   a. epidemiological studies associate high-fiber diets with lower risk of colon cancer
   b. other factors such as low fat and low kcalories may explain the apparent relationship between dietary fiber and colon cancer
   c. the National Cancer Institute recommends that people eat more foods with fiber

7. Cholesterol levels in the blood may decrease with some types of fiber in the diet, but fat levels are probably more important than fiber

G. Recommendations can be used to assess your carbohydrate intake — Nutrition News Solomons, N.W. 1986. 49: 1-3

1. you can keep a food record and add up the amounts of carbohydrates to find your daily intake and compare it to recommendations
   a. a minimum of 100 grams of carbohydrates is needed for the central nervous system, red blood cell metabolism, and fat metabolism
   b. the World Health Organization suggests a minimum of 180 grams daily
   c. the Basic Food Guide minimums provide 110 to 200 grams of carbohydrates
2. most people, especially athletes, should get 50 to 60% of their kcalories from carbohydrates
3. recommendations for dietary fiber are more tentative than for some nutrients
   a. according to the Dietary Guidelines for Americans, you should select foods that are good sources of fiber and starch--whole grain breads, cereals, fruits, vegetables, beans, peas, and nuts
   b. the National Institutes of Health suggest a total of 25-35 grams of fiber per day, and Americans now average only 10-20 grams per day
4. in order to increase your intake of fiber and carbohydrates, you can add fruits, vegetables, grains, cereals, pastas, breads, and cooked dry beans or peas
   a. you may need to decrease your intake of foods high in fat, sugar, and alcohol to keep kcalorie levels from increasing
   b. if you add bran to your diet as a source of fiber, limit it to one serving per day

IV. Study Vocabulary (Suggested)

A. Photosynthesis
B. Lactose
C. Mannitol
D. Sorbitol
E. Cellulose
F. Pectin
G. Insulin
H. Epinephine
I. Pancreas
J. Cholesterol

V. Student Exercise

A. Develop three dimensional models of glucose, disaccharides and monosaccharides and explain function
B. Develop list of foods and research sugar content and type
C. Develop individual carbohydrate intake chart
D. Do oral report on diseases associated with carbohydrates, athletic activities, and disease control
E. Unit test

VI. Outcomes

A. Students will understand the role of carbohydrates in normal body function, disease control and illness
B. Students will have a knowledge of the many forms of sugar and the types of diabetes
C. Students will have an insight on how carbohydrates affect performance

UNIT 6

PROTEIN:
BEHAVIORAL OBJECTIVE – The Student will know how the body handles protein in digestion, absorption, transportation, and protein excesses. The student will also know the significance of low protein intake, high protein intake and assessment.
MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. Know the basic characteristics of protein molecules and their amino acid components B. Know the amino acid combinations and determine quality of a protein or combination of proteins C. State the three basic functions of protein and amino acids D. Know the forms proteins commonly take in processed foods E. Know the processes that take place to digest and absorb protein from foods F. Know recommendations for reasonable protein intake F. Know the consequences of consuming too few or too many proteins	
II. Pre-test	Teacher made
III. Content A. Protein is an extremely important nutrient, but its value has been overrated 1. long-term lack of adequate protein causes a person to lose muscle, decline in physical and mental abilities, and break down vital organs 2. severe lack of protein and kcalories over time can cause death 3. protein foods are the central feature of many meals, and the popular media glorify protein and its sources	Nutrition for Living Pg. 170-197
B. The structure of proteins is very complex 1. all proteins are made of amino acids a. amino acids contain nitrogen in addition to carbon, hydrogen, oxygen and sometimes sulfur b. amino acids link together to form chains known as dipeptides, tripeptides, and polypeptides, based on the number of amino acids that are joined by peptide bonds 2. most proteins contain hundreds of amino acids in a very specific sequence a. different animals and plants contain the same 20 amino acids, but in different sequences and proportions b. DNA contains the codes that determine these specific sequences and formations	Textbook of Medical Physiology Guyton, A. C. 1981

C. Nitrogen and essential amino acids are the parts of proteins that the body requires from foods
   1. most foods have some proteins, so protein and kcalorie intakes tend to be related to each other
   2. a high-quality protein contains the amino acids the body needs for protein synthesis but cannot produce for itself
      a. there are 9 essential amino acids
      b. animal foods tend to be of higher quality than plants, because they have generous amounts of the 9 essential amino acids
      c. eggs and milk are sometimes used as reference proteins because of their superior quality
      d. vegetable proteins are often poor sources of one or more amino acids, so they are considered fair in quality
   3. protein quality is indicated by a protein efficiency ratio (a simple measure of how fast an animal grows on a minimal intake of protein from a particular food)
   4. the protein quality of one food is less important than the balance of amino acids provided by all the foods that are eaten together
      a. when two foods provide proteins that make up for each other's shortcomings in amino acids, the proteins are said to complement each other
      b. complementing is advised for vegetarians who avoid all animal products (vegans) and for those who have high protein needs, especially growing children, pregnant women, and lactating mothers
      c. semi-vegetarians, lacto-ovo vegetarians and lactovegetarians generally get enough of the essential amino acids if they eat foods that have enough protein to meet their RDAs
      d. fruitarian and (Zen) macrobiotic diets are unsafe because they are inadequate in protein as well as other nutrients
   5. nutrition labeling includes two U.S. RDA values for proteins: 45 grams for high-quality proteins such as those in meat, eggs, and milk, and 65 grams for lower-quality proteins

D. Proteins contribute to body structure, regulate body processes, and provide energy
   1. most cell components and body tissues contain a substantial amount of proteins
      a. the DNA in a person's cells determines which proteins are synthesized
      b. in sickle cell anemia there is a slight defect in the DNA coding for hemoglobin in the blood, resulting in a serious disease

2. many body functions are regulated by processes involving protein
    a. enzymes, hemoglobin, and myoglobin are body proteins that facilitate biochemical reactions, transfer oxygen to body cells, and carry oxygen in muscle cells, respectively
    b. many hormones are proteins or short amino acid chains
    c. protein is a major component of antibodies and skin, which both protect the body from bacteria
    d. proteins form cell membrane pumps that move electrolytes into and out of cells
    e. soluble proteins in the blood are a necessary part of the process that balances osmotic pressures inside and outside of cells
    f. protein buffers prevent large changes in the pH of body fluids
    g. neurotransmitters are made of amino acid precursors
        i. serotonin, dopamine, and norepinephrine are made from amino acids and may be influenced somewhat by diet
        ii. large doses of single amino acids are not recommended
3. proteins can provide fuel to produce body energy when carbohydrate and fat supplies are inadequate, and kcalories from excess protein intake can be stored as body fat

E. Proteins and amino acids are used in food processing
1. examples include: soy protein isolates in meat analogues, soy protein concentrates, tofu, miso, surini, and casein
2. amino acids are also used in food processing
    a. protein powders have been marketed for various applications
    b. aspartame is a dipeptide used as an artificial sweetener (Nutrasweet)
        i. aspartame has been tested and found to be safe in the levels used in foods, but complaints of adverse reactions have led to another round of tests currently underway
        ii. because there are some people with the rare disease phenylketonuria who must monitor their intake of phenylalanine, one of the amino acids in aspartame, products with aspartame bear special labels
    c. thaumatin is another protein sweetener that may be approved for food use in the future

F. Proteins are efficiently digested and absorbed
   1. stomach acid denatures the large proteins, and pepsin breaks large proteins into polypeptides
   2. protease enzymes from the pancreas break polypeptides into amino acids, dipeptides, tripeptides, and enzymes from the intestinal wall complete the process to form amino acids for absorption

G. Food allergies are caused by deviations in protein absorption
   1. infants and persons with illnesses sometimes absorb damaging proteins
      a. sensitization occurs when allergens (antigens) from food are absorbed and antibodies are produced to attack them
      b. symptoms may be asthma, sneezing, rashes, hives, headaches, dizziness, rapid heartbeat, blood in the urine, vomiting, or diarrhea
      c. reaction time varies from immediately to 72 hours
      d. cows' milk, egg white, peanuts, wheat, soybeans, shrimp, tomato, codfish, and crab are common allergens
      e. people who self-diagnose allergies may unwittingly eliminate important sources of nutrients from their diets
      f. skin prick tests and food challenges are more reliable than cytotoxic testing and sublingual challenges
      g. only 2% of people have true food allergies
   2. people with "Chinese restaurant syndrome" react adversely to monosodium glutamate, but it takes more than just MSG to trigger the problem
   3. much of the body's supply of amino acids comes from tearing down and replacing body proteins
      a. 3% of the body's proteins are replaced every day
      b. turnover is fastest for cells in the gastrointestinal tract
      c. some amino acids are reused for building new proteins, and some are discarded

H. Problems occur with protein shortages and protein excesses
   1. protein deficiency rarely occurs by itself
      a. people who eat mostly cassava can have protein deficiency which shows up as poor growth and increased infections
      b. most parts of the world do not suffer protein shortages apart from total shortages of food and kcalories

Adverse Reaction to Foods
N.H. Publication No. 84-2442
U.S. Department of Health, 1984

2. protein-energy malnutrition (PEM) occurs when people don't have enough food
    a. children are particularly susceptible
    b. marasmus is one type of PEM in which people become extremely thin and weak, with low resistance to infection
    c. children with kwashiorkor are swollen with fluid because of low blood proteins, their hair turns red, their skin gets dry and scaly, they have frequent infections, and their livers become damaged
    d. infections are common with protein deficiency, even when it doesn't progress as far as marasmus and kwashiorkor
    e. fatty liver is a sign of protein deficiency or alcoholism
3. taking in too much protein can also cause adverse effects
    a. since protein provides energy (kcalories), excessive protein intake can result in obesity
    b. high-protein diets are often high in fat
    c. proteins make the kidneys work harder to excrete nitrogen as urea, a process which demands a lot of water
    d. since calcium is excreted in larger amounts with high-protein intakes, osteoporosis can be a long-term consequence

I. Protein needs are easily met

Journal of the American Dietetic Association 1987 87: 933-939

1. protein needs are estimated by measuring how much nitrogen a person consumes and how much nitrogen is excreted in the urine
    a. the amount of nitrogen (protein) intake that matches its output indicates how much protein the person uses for body processes (other than growth)
    b. if output and intake are the same, the person is in balance, neither gaining nor losing nitrogen
    c. negative balance means the person is losing protein from his body tissues, as with injury or starvation
    d. positive balance indicates the person is making new tissue, usually in periods of growth
    e. if kcalorie intakes are inadequate, a person needs more protein to be in balance
2. protein RDAs are more adequate for nitrogen balance, except during illness or injury

3. protein RDAs are based on ideal weight
   a. multiplying your ideal weight in kilograms by 0.8 grams of protein per kg gives you an estimate of an adult's protein needs
   b. extra protein is recommended for periods of growth
      i. pregnant women should add 30 grams of protein to the above recommendations
      ii. lactating women need an additional 20 grams of protein
      iii. children need 2.2 grams of protein per kg of body weight as infants, and amounts between 0.8 and 2.2 grams of protein per kilogram as they grow older
4. most people need about 10-12% of their kcalories from protein
   a. elderly people might need more for nitrogen balance
   b. Americans get about 16% of their total kcalories from protein
5. athletes need about 1 gram of protein per kilogram of body weight
   a. fat and carbohydrates are the preferred fuel for muscles, but 15% of energy can come from protein during heavy exercise
   b. the American Dietetic Association recommends that athletes take in 12-15% of kcalories from protein

IV. Study Vocabulary (Suggested)

A. Dipeptides
B. Tripeptides
C. Polypeptides
D. D.N.A.
E. Vegans
F. Fruitarians
G. Synthesized
H. Hemoglobin
I. Aspartame
J. Thaumatin
K. Allergies
L. Cassava
M. Kwashiorkor

V. Student Exercise

A. Draw and explain amino acid structures
B. Draw and explain an example of a protein
C. Develop a list of foods commonly found in a supermarket and chart the number of grams of protein found in the items

D. Informational essays on:
   1. proteins in processed foods
   2. sweeteners
   3. food allergies
   4. M.S.G.
   5. protein risk

E. Unit test

VI. Outcomes

A. The Student will know about foods high in protein, how protein is digested and absorbed and the quality of proteins in foods consumed.

B. The Student will gain an understanding of how the body uses protein upon entering the blood stream and how the body excretes the excesses

VII. Resources

A. Snacks: The Foods You Hate to Love: filmstrips

B. Eating on the Run: videocassette

C. Dangerous Dieting: The Wrong Way to Lose Weight: filmstrips or videocassettes on fad diets, anorexia, bulimea

UNIT 7

LIPIDS
BEHAVIORAL OBJECTIVE - The Student will know the functions of lipids, mechanisms of digestion and body utilization as well as location of lipids in the body, association with major diseases and assessment methods.
MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. List the six important lipid functions B. Know the common forms of lipids and be able to describe differences C. Identify foods high in lipids and those with modified lipids D. Know the main processes of digestion, absorption and transportation of lipid substances E. Know body locations of triglycerides, phospholipids and cholesterol F. Understand association and controversies involving lipids and the development of atherosclerosis and cancer G. Assess lipid intake	
II. Pre-test	Teacher made
III. Content A. Lipids are fatty substances that dissolve in ether but not water 1. solid lipids are called fats 2. liquid lipids are called oils	Nutrition for Living Pg. 138-168
B. There are six major reasons that lipids are important 1. since lipids provide 9 kcalories per gram, they are more efficient for energy storage than glycogen in terms of weight 2. linoleic acid (and perhaps linolenic acid) is essential for growth 3. fat-soluble vitamins are absorbed along with fat 4. lipids are part of cell membranes, certain hormones, the coating on nerves, vitamin D, and digestive secretions 5. lipids insulate the interior of the body 6. internal organs are cushioned and protected by adipose tissues	Textbook of Medical Physiology Guyton, A.C. 1981
C. Glycerides, phospholipids, and sterols are the main forms of lipids in the diet and body 1. glycerides have a 3-carbon backbone to which one to three fatty acids are attached a. triglycerides account for 90% of food lipids, both fats and oils	

b. the number of carbons in the fatty acid chains and the degree of saturation determine the characteristics of a triglyceride
   i. shorter chain-length fatty acids tend to be more liquid
   ii. triglycerides with mostly saturated fatty acids, found in animal fats, coconut, and palm oils, tend to be solid at room temperature
   iii. monounsaturates, found in olives and avocados, have one double bond and are liquid
   iv. polyunsaturated fatty acids, found in fish and most plants, have two or more double bonds and are liquid

2. phospholipids like lecithin are similar to triglycerides, except that one carbon chain contains phosphorus
3. sterols like cholesterol have structures very different from those of triglycerides
   a. cholesterol is found only in animal cells, not plants
   b. cholesterol is high in eggs and organ meats
4. lipids are used in processed foods
   a. lecithin and mono- and diglycerides are good emulsifiers
   b. hydrogenated oils become firm and spreadable and have a longer shelf life
   c. sucrose polyester is a fat that cannot be digested

D. Foods have visible and hidden fat
1. processing adds fat to some foods and removes fat from others
2. the amount of cholesterol in most animal foods is quite small
3. lipids often undergo structural conversions as they are being digested, as they pass through the liver, and as they circulate in the blood
4. bile and lipase enzymes in the small intestine do most of the digestion of lipids in the small intestine
   a. bile from the liver breaks apart lipid droplets
   b. lipases from the pancreas and small intestine strip fatty acids off the glycerol molecule
   c. fatty acids and monoglycerides combine with bile salts to form micelles before they are absorbed
   d. enzymes in the small intestine remove fatty acid molecules that are attached to cholesterol, and micelles promote absorption

5. lipoproteins are formed so that absorbed lipids can be transported in the bloodstream
   a. triglycerides, phospholipids, and cholesterol form round globules coated with proteins to make them soluble
   b. most lipids leave the intestinal cell wall inside lipoproteins called chylomicrons, which pass through the lymphatic system before entering the bloodstream
   c. since short-chain fatty acids and glycerol are water soluble, they are absorbed directly into the bloodstream
6. the liver rearranges lipids in the blood to form various lipoproteins
   a. lipoproteins are classified according to their density, which is an indication of their relative content of protein and cholesterol
   b. the body produces its own cholesterol and usually produces less when there is a lot of cholesterol available from the diet

E. Different types of lipids concentrate in specific parts of the body

Journal of American Medical Association
Levy, R.I., 1982
248: 2888-2889

1. triglycerides are removed from lipoproteins in the blood and taken up by cells for energy production
   a. extra triglycerides are taken up by adipose cells and stored
   b. about 15% of a man's body and 20-25% of a woman's body consists of stored fat
   c. distribution of fat is an inherited trait, with males depositing more fat in the abdomen and females around the hips and thighs
   d. fat cells shrink when fat is removed for energy, but they do not disappear
2. phospholipids help determine what can pass through cell membranes
   a. choline is part of the phospholipid lecithin and a precursor of the neurotransmitter acetylcholine
   b. acetylcholine is involved in memory processes, but taking extra choline does not improve memory in normal adults
3. about 20% of the cholesterol in your body is circulating in the blood
   a. around 65% of blood cholesterol is in low-density lipoproteins
   b. HDL cholesterol is more likely to be removed from the blood by the liver and secreted as bile
   c. the amount of LDL circulating in the blood is partly determined by how fast cells remove it, and that is determined by the presence of LDL receptors on the surface of the cells

F. Lipids are associated with development of obesity, heart disease, and some forms of cancer

American Journal of Clinical Nutrition
Harper, A.E., 1983
Coronary Heart Disease
37: 669-681

1. lipids are a concentrated source of kcalories in the diet at 9 kcalories per gram, but in some situations the effective energy available to the body may possibly be closer to 11 kcalories per gram
2. dietary lipids may play a role in the development of atherosclerosis
   a. in atherosclerosis a blood vessel becomes coated with plaque, narrow, and less elastic
      i. vessels containing plaque can rupture or become blocked, causing death in the cells to which they deliver blood
      ii. when blood flow to the brain is cut off, a stroke (cerebrovascular accident) occurs
      iii. when the heart fails to receive blood because of atherosclerosis, a heart attack (myocardial infarction or coronary occlusion) happens
      iv. deposition of plaque in the arteries causes cardiovascular disease, or, when it occurs in the arteries that feed the heart, coronary heart disease
   b. certain risk factors have been associated with increased incidence of coronary heart disease (CHD)
      i. male gender, advanced age, and family history are uncontrollable risk factors for CHD
      ii. high blood pressure, high blood cholesterol, and abnormal electrocardiogram readings are clinical measurement risk factors
      iii. smoking, eating too many kcalories or too much fat, inactivity, and using birth control pills are living habit risk factors
      iv. some vegetarians have lower risk of CHD than the general population
   c. if LDL cholesterol is high and HDL is low, a person is at greater risk of CHD
   d. changing the diet can lower blood cholesterol in some people more than others, and with varying effects on LDL and HDL forms of cholesterol
      i. reducing total fat is safe but appears to lower both LDL and HDL
      ii. replacing saturated fats with less saturated fats has variable effects on blood cholesterol
      d[1]) using polyunsaturated oils from plants instead of saturated fats lowers both LDL and HDL but may promote development of cancer

d[2]) linolenic acid in polyunsaturated fats acts to lower blood pressure, but linoleic acid can cause blood pressure to rise
d[3]) if saturated fats are replaced by polyunsaturated oils in fish, cholesterol levels decrease and fewer deaths result from CHD

iii. substituting monounsaturated fats for saturated fats tends to lower cholesterol in the blood, with more effect on LDL than HDL
iv. consuming less cholesterol has small, variable effects on blood cholesterol levels

3. intervention studies to lower the incidence of CHD by reducing risk factors had mixed results and are difficult to interpret because changes in several risk factors occurred together
   a. a study of men in Oslo, Norway showed a 47% decline in heart attacks in those who quit or decreased smoking and changed their diets
   b. the Multiple Risk Factor Intervention Trial (MRFIT) compared results of standard high blood pressure treatment to treatment that included intensive counseling on smoking, diet, and aggressive medication, but there was not a significant difference in death rates between the two groups
   c. a Lipid Research Clinics study used a cholesterol-lowering diet plus a cholesterol-lowering drug to treat middle-aged men with high blood cholesterol and found a difference in heart attacks, but it may have been attributable to the drug more than to the diet itself
   d. fish eaters in the Netherlands were found to have fewer deaths from CHD than non-fish eaters
      i. fish oils contain a special type of polyunsaturated fatty acid known as omega-3 and a particular omega-3 fatty acid called eicosapentaenoic acid (EPA)
      ii. omega-3 fatty acids promote production of a type of prostaglandin that slows down blood clotting
   e. nutrition experts do not agree on who should make changes in their diets to lower the risk of CHD
      i. some experts suggest that everybody should limit fat to 30T of kcalories and cut down on saturated fat and cholesterol intake
      ii. others believe that only high-risk persons should be identified and encouraged to make these types of changes

4. cancer is a group of diseases that takes place in stages — Journal National Cancer Institute, Borssonneault, G.A., Elson, C.E., Pariza, M.W., 1986 76: 335-338
   a. initiation of cells precedes promotion and progression in the development of cancer
   b. environmental carcinogens include dietary factors such as lipids, alcohol, and mold toxins
      i. epidemiological data show correlations with lipid intake and incidence of breast, colon and prostate cancer
      ii. people who move to another country tend to change to the new country's cancer rates after one or two generations
      iii. Seventh Day Adventists have lower rates of cancer than the general population, partly because they don't smoke or drink alcohol, but possibly also because many are vegetarians and eat low fat diets
      iv. animals on low fat diets develop fewer tumors than those fed high levels of fat, but the difference in calories may be more important than the fat level itself
      v. total fat is more important than the type of fat in cancer development
      vi. low blood cholesterol levels are associated with cancer, but this might be because cancer development causes blood levels of cholesterol to fall
      vii. several official agencies include reducing fat intake in their recommendations for lowering cancer risk

G. Compare your personal fat intake with recommended levels
   1. linoleic acid needs to be at least 1-2% of kcalories but you need not worry because the American diet is usually around 6%
   2. the current U.S. fat intake, 43% of total kcalories, is much higher than the recommendations from the RDA committee (up to 35%), the World Health Organization (30-35%), or the recommendations of 30% or less from the American Heart Association and the National Academy of Sciences Committee on Diet, Nutrition, and Cancer
   3. cholesterol should be 300 mg per day or less
   4. to assess your intake:
      a. find total intake of fat, cholesterol and kcalories by adding up the amounts in individual foods
      b. convert grams of fat to kcalories and divide by total kcalorie intake to find percentage of kcalories from fat

IV. Study Vocabulary (Suggested)

A. Adipose
B. Monounsaturates
C. Polyunsaturates
D. Cholesterol
E. Bile
F. Lumphatic
G. Plaque
H. Linolenic acid
I. Omega 3
J. Carcinogens
K. Electrocardiogram

V. Student Exercises

A. Develop list of foods within a particular food group and identify lipid amounts
B. Invite and/or organize a panel discussion concerning heart disease and its association with lipids
C. Investigate sale promotions concerning fish oils and their uses
D. Unit test

VI. Outcomes

The student will know what lipids are good for and what damage lipids can cause

VII. Resources

A. Obesity: Eating our Way to our Graves: slides and cassette
B. The Culinary Hearts Kitchen Course: slides
C. Supermarket Savvy: videocassette
D. Taking Control: slides or videos on diet and cancer prevention

MINERALS

BEHAVIORAL OBJECTIVE - The Student will know minerals as compared to other nutrients and an understanding of macrominerals and trace minerals. Student will also know about 17 minerals in terms of function, intake, deficiencies, and excesses.

MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. List major similarities and differences between vitamins and minerals B. Identify minerals according to macromineral and trace mineral categories C. Understand difficulties in determining if a particular mineral is essential for human diets D. Know factors that increase or decrease the bioavailability of minerals E. List main functions, dietary sources, and recommended vs. typical intake of: calcium, phosphorus, magnesium, sulfur, sodium, potassium, chloride, iron, iodine, fluoride, zinc, selenium, copper, cobalt, chromium, manganese, and molybdenum F. Understand common causes and consequences of mineral deficiencies and excess intake G. Determine nutrient density in foods consumed	
II. Pre-test	Teacher made
III. Content	
A. Minerals as single elements together amount to only 4% of a body's total weight 1. calcium, phosphorus, sulfur, potassium, sodium, chloride, and magnesium are macrominerals 2. iron, iodine, fluoride, zinc, selenium, copper, chromium, manganese, molybdenum, cobalt, silicon, arsenic, nickel, and vanadium are trace minerals; they make up less than 1/100 of a percent of the body's total weight 3. several minerals are essential in the diet, but for many of the minerals it is difficult to determine essentiality a. a mineral's importance in the body is not always related to its prevalence in the body b. a mineral's essentiality is usually determined by detecting serious negative results from diets that are very low or devoid of that mineral	Nutrition for Living Pg. 312-347

B. The bioavailability of minerals is important and variable
   1. minerals are absorbed less efficiently than macronutrients
   2. few factors improve the bioavailability of minerals
      a. iron bioavailability depends on the form of the mineral, with heme iron from animal flesh absorbed more efficiently than nonheme iron
      b. nonheme iron is absorbed better when there is a high level of vitamin C in the same meal
      c. an unidentified meat factor increases the absorption of nonheme iron
      d. iron and zinc in breast milk are efficiently absorbed for unknown reasons
      e. other nutrients such as vitamin D, lactose, and protein increase the absorption of certain minerals
   3. mineral bioavailability can be decreased by several factors
      a. dietary fiber and the phytate that is often found in high-fiber foods can interfere with mineral absorption
         i. calcium-phytate-zinc complexes are even less absorbable than calcium-phytate combinations
         ii. breads leavened with yeast have less phytate than unleavened bread
         iii. the effect of phytate and fiber is usually not great enough to cause problems unless the diet is poor, or a person is using large amounts of bran supplements
      b. tannins in tea and sorghum inhibit mineral absorption
      c. some other food substances interfere with the availability of certain minerals; e.g., oxalates and calcium, ascorbic acid and copper, protein and calcium, and phosphorus and calcium
      d. minerals interfere with each other when the level of one is very high
         i. large amounts of calcium can interfere with magnesium, zinc, and iron absorption
         ii. zinc can interfere with copper and iron absorption, and manganese can interfere with iron absorption
         iii. calcium and iron can lower lead bioavailability, and selenium can make mercury less toxic
      e. pica (eating substances that are not considered food) can be dangerous
         i. eating paint chips can cause lead poisoning
         ii. eating clay can interfere with iron and zinc absorption

Journal of the American Dietetic Association 1980 Harland, B.F., Johnson, R.D., Blendermann, E.H. "Total Diet" 77: 16-20

f. medications can affect mineral (and vitamin) requirements and utilization
   i. antacids that contain aluminum decrease absorption of phosphorus and fluoride
   ii. minerals sometimes interfere with drugs, as in the case of calcium and the antibiotic tetracycline

4. iron, calcium, phosphorus, magnesium, and zinc are absorbed more efficiently when the body's reserves of those minerals are low

C. Minerals form tissue structure, help maintain water balance and acid/base balance, form some regulatory substances such as enzymes and hormones, and facilitate nerve and muscle function

Annual Review of Nutrition 1986
Karanja, N., McCarron, D.A., 1986
0: 475-484

1. calcium and phosphorus are the most prevalent minerals in the body
   a. hydroxyapatite crystals are deposited in a collagen (protein) framework to give strength to bones; when bones are taken apart and reassembled at the same rate, they are in homeostasis or dynamic equilibrium
   b. phosphorus also plays a role in cell membrane formulation, phospholipids, DNA, RNA, some coenzymes, ATP, acid/base balance, transmission of nerve impulses, and blood clotting
   c. the RDAs for calcium and phosphorus are both 800 mg; 1,200 mg-RDAs are set for teenagers, pregnant women, and lactating mothers
      i. some experts believe the RDA for women should be even higher (1,000-1,500 mg) to maintain bones
      ii. the average woman consumes only 2/3-3/4 of the current RDA
      iii. average phosphorus intakes are higher than calcium intakes, but no harmful effects have been revealed in metabolic studies
   d. milk and other dairy products provide most of the calcium in U.S. diets
      i. two servings of milk products in the Basic Food Guide provide 600 mg of calcium
      ii. if you cannot drink milk due to lactose intolerance, you can get your calcium by using lactose enzyme products; trying yogurt, cheese, or other milk products; using milk in cooking; and eating leafy green vegetables, legumes, nuts, and fish with edible bones
      iii. plant sources of calcium have lower bioavailabilities than milk products
      iv. calcium supplements should be chosen carefully and used in moderation because some forms contain lead, and too much calcium can interfere with utilization of other minerals

v. foods with calcium usually contain phosphorus, but there are many foods with phosphorus that do not contain calcium

e. osteoporosis, rickets, and osteomalacia are bone diseases related in part to calcium balance
   i. in rickets and osteomalacia, decreases in bone minerals in proportion to the amount of bone matrix leads to softening of the bones; this condition is caused by inadequate vitamin D, or abnormalities in calcium and phosphorus absorption and retention, not by inadequate dietary calcium
   ii. both bone matrix and minerals are lost is osteoporosis such that bones become brittle and easily fractured
   iii. osteoporosis is more common in women than men, in whites and Asians than Blacks, in women after menopause, and in female marathon runners who have menstrual irregularities
   iv. estrogen hormone levels, age, and calcium intake are some of the factors related to osteoporosis development
   v. if calcium intakes help prevent osteoporosis, the benefits are likely to be greatest in teenage women who are building bone mass
   vi. estrogen therapy, weight-bearing exercise, and supplements of calcium, vitamin D, and fluoride help slow down bone loss in some circumstances, but some of these methods have substantial risks

f. a vitamin D metabolite and parathyroid hormone keep the levels of calcium in blood very stable by affecting the rates of calcium absorption, deposition in bones, and excretion by the kidneys

g. low calcium intakes have been related to high blood pressure in some studies, but this is controversial

2. magnesium, another component of bone, has many other functions
   a. magnesium is present in many enzymes, it is necessary for transmission of nerve impulses, it affects muscle contraction, and it stabilizes DNA and RNA
   b. people's magnesium intakes are usually lower than the RDAs of 300 mg for women and 350 for men, but adverse effects of these levels are not known
   c. people who have a lot of magnesium in their water supply tend to have less cardiovascular disease, but this may not be a cause and effect relationship
   d. whole grains, nuts, legumes, seafood, leafy green vegetables, meats, and milk provide magnesium
   e. both insufficient and excessive magnesium intakes can cause neurological disturbances

3. sulfur is part of thiamine, biotin, and three amino acids
   a. sulfur in a form combined with oxygen helps control acid/base balance
   b. sulfur is a component of cartilage, tendons, and proteins
   c. sulfur intake and deficiency are both tied to levels of protein intake
   d. an excess of sulfur amino acids can cause liver damage and depressed growth
   e. there is no RDA for sulfur because its requirements are met by adequate protein intake
4. potassium, sodium, and chloride are electrolytes that work together to help maintain water balance
   a. potassium, magnesium, phosphates, and sulfates are the electrolytes that are more concentrated inside cells, and sodium and chloride are more concentrated outside cells
      i. movement of ions across membranes is necessary for nerve impulses and muscle contractions
      ii. chloride is part of a buffer system
   b. safe and adequate ranges the RDA Committee has established for these three electrolytes fall between 1,100 and 5,700 mg per day
      i. sodium chloride is 40% sodium
      ii. the average adult's consumption of sodium is much more than the 200 mg needed to prevent deficiency
      iii. sodium and chloride are primary electrolytes of sweat
         b) since sweat is more dilute than blood, replacing water losses is more important than replacing electrolytes
         b) replacement of sodium and chloride is necessary when sweat losses exceed 6-8% of body weight
         b) salt tablets are not necessary and can irritate the stomach lining
   c. salt and foods with added salt are the main sources of sodium and chloride; 40% of the sodium in our foods is added in processing
      i. drinking water usually provides less than 100 mg of sodium per day
      ii. some medications have more than 200 mg of sodium per dose
      iii. meats, milk, fruits, vegetables, legumes, nuts, and whole grains provide potassium
      iv. unlike sodium, potassium is likely to be reduced in processed foods

Food Technology 1980 Institute of Food Technologist Dietary Salt 34: 85-91

d. between 9 and 20% of Americans develop essential hypertension
    i. for people prone to hypertension, restricting sodium might prevent the onset of the disease, or at least make it possible to treat the hypertension with lower doses of drugs
    ii. overfatness and intake of other minerals such as chloride, potassium, calcium and magnesium are thought to contribute to the development of hypertension

5. iron is the trace mineral with the largest quantities in the body — American Journal of Clinical Nutrition 1978, Monsen, E.R., Halberg, M., Layrisse, D.M., "Estimation of Availabile Dietary Iron" 31: 134-141
    a. iron is part of hemoglobin, myoglobin and many enzymes
    b. the RDA for iron is 18 mg for women and adolescents and 10 mg for men; an extra 30-60 mg of iron is recommended for women during pregnancy and the first few months after delivery
    c. animal flesh, with its high bioavailability, is the best source of iron
        i. eggs, legumes, nuts, whole grains, enriched cereals, and green leafy vegetables provide nonheme iron in the diet
        ii. dried fruits and molasses contain iron, but they are so high in kcalories that they are not preferable sources
    d. anemia occurs in many forms, of which the most common is iron-deficiency anemia
        i. preschool children, adolescents, menstruating women, and the elderly are most susceptible to development of iron deficiency anemia in the U.S.
        ii. Blacks and people living in poverty are anemic more often than whites and people with higher incomes
        iii. sports anemia is a transiet condition that corrects itself with consumption of protein and iron to meet RDAs
        iv. anemia results in less efficient delivery of oxygen and removal of carbon dioxide from the body, thus causing a "run down" feeling, decreased work capacity, and depressed immune function
    e. giving large amounts of iron to malnourished children too rapidly can increase their susceptibility to infection
    f. a large overdose of iron can cause shock and death; long-term overdose can cause liver and heart damage

6. iodine is part of thyroid hormones
   a. thyroid hormones stimulate oxygen consumption, basal metabolism, cell development and growth
   b. iodine RDAs are 150 ug for adults (approximately 1/100 those of iron)
   c. ocean fish, iodized salt, milk, and commercially-baked bread are sources of iodine, sometimes amounting to intakes well above RDAs
   d. iodine deficiency causes goiter, an enlarged thyroid gland
      i. iodine deficiency in pregnancy can cause cretinism in the baby
      ii. some foods and drugs contain substances that prevent incorporation of iodine in thyroid hormones
   e. iodine excesses can also cause a form of goiter
7. fluoride makes hydroxyapatite crystals larger and less soluble
   a. dietary fluoride can improve resistance to dental caries and possibly osteoporosis
   b. the RDA safe and adequate range for fluoride is 1.5-4.0 mg for adults (about 1/10 - 1/4 of iron RDAs)
   c. water and edible fish bones provide fluoride in the diet
   d. excess fluoride causes tooth discoloration and skeletal deformities
8. zinc is part of over 70 enzyme systems
   a. zinc is necessary for proper immune function
   b. the zinc RDA is 15 mg for men and women (between the male and female RDAs for iron)
   c. zinc is provided by seafood, red meats, nuts, legumes, and other foods, but foods with fiber and phytate have low bioavailability
   d. zinc deficiency causes growth failure, loss of appetite and taste, dermatitis, and delayed wound healing
      i. zinc deficiency occurs most commonly where the diet is low in zinc, the bioavailability is low, and infections and parasites prevail
      ii. zinc deficiency has been identified in parts of the Middle East
      iii. low birth weight infants and the elderly may have some problems stemming from inadequate zinc status
   e. high intakes of zinc do not improve sexual performance, but they can depress immune function and impair copper absorption

National Research Council 1980 Recommended Dietary Advances

9. selenium works together with vitamin E in most of its functions
    a. glutathione peroxidase enzyme contains selenium and prevents oxygen from damaging cells
    b. the RDA safe and adequate range for selenium is 0.05-0.2 mg (less than 1/100 the iron RDAs)
    c. selenium is provided by grains, meats, fish, and poultry, but the amount in plant foods varies with the selenium in the soil
    d. selenium deficiency causes muscle pain and contributes to the development of Keshan disease (heart damage) in China
    e. selenium toxicity results in loss of hair and fingernails
10. copper is a trace element with many functions
    a. copper is part of many enzymes, is needed for collagen synthesis, helps metabolize iron, and promotes normal cardiovascular and immune function
    b. the safe and adequate range for copper is 2.0-3.0 mg (about 1/4 the iron RDA)
    c. seafood, nuts, legumes, organ meats, and many other foods provide copper
    d. copper intakes frequently reach only 1/2 the amount recommended
    e. deficiency of copper causes anemia, bone defects, and cardiovascular changes
    f. copper toxicity can harm the liver and nervous system
11. manganese is another mineral found in several enzymes
    a. the safe and adequate range of manganese intake falls between 2.5 and 5.0 mg (a bit higher than that of copper)
    b. nuts, vegetables, fruits, and grains are sources of manganese
    c. manganese deficiency results in abnormal bone and cartilage
    d. manganese toxicity causes neuromuscular defects
12. cobalt is part of vitamin B-12, its functions, sources, deficiency, and toxicity are all related to this vitamin
13. chromium is necessary for normal metabolism of blood glucose
    a. chromium works with insulin to control glucose metabolism
    b. the safe and adequate range for chromium is 0.05-0.2 mg (the same as the range for selenium)

c. Brewer's yeast, liver, and seafood are food sources of chromium
d. lack of chromium may be one of many factors that contribute to the development of non-insulin-dependent diabetes
e. effects of excess dietary chromium have not been studied

14. molybdenum is also a component of several enzymes
a. the safe and adequate range for molybdenum is 0.15-0.5 mg (about three times as high as the safe and adequate ranges for chromium and selenium)
b. legumes, cereals, and vegetables contain variable amounts of molybdenum
c. deficiency of molybdenum interferes with nitrogen excretion
d. its toxicity interferes with cobalt metabolism

15. levels of copper, manganese, cobalt, chromium and molybdenum in food are extremely difficult to measure
a. refinement (processing) removes these minerals from many foods
b. persons who consume a varied diet are not likely to have inadequate intakes of any of these minerals

D. General statements regarding mineral deficiencies and excess intakes

1. deficiencies are more likely with limited quantity of food, poorly selected food, low bioavailability, defective absorption or utilization, and/or unusually high requirements
a. these conditions are most often encountered by elderly persons, pregnant vegetarians, and people living in poverty
b. deficiencies of most minerals cause difficulties with reproduction and immunity

2. ingesting excessive amounts of most minerals interferes with the absorption of other minerals and causes forms of toxicity that can differ based on whether the excessive intake was acute or chronic
a. acute toxicity usually causes vomiting, diarrhea, and nausea
b. lead, cadmium, and mercury are most likely to be toxic with chronic exposure
c. children and people with genetic predispositions are most sensitive to mineral overdoses

E. Mineral intakes can be evaluated by several methods
   1. a diet that follows the Basic Food Guide recommendations is likely to provide at least 1/2 to 2/3 of recommended mineral intakes
   2. calculating intakes with food composition tables can be done for many of the minerals
   3. nutrient density is based on the nutrient content of a 100 kcalorie portion of food

F. To optimize intake of minerals, eat foods from the basic groups; vary your choices; choose less processed forms; be particularly careful to choose foods that are good sources of calcium, zinc, and iron if you are a vegan; and do not take mineral supplements

IV. Study Vocabulary (Suggested)

A. Heme iron
B. Phytate
C. Tannins
D. Collagen
E. Osteoporosis
F. Skeletal
G. Matrix
H. Estrogen
I. Cartilage
J. Electrolytes
K. Hypertension
L. Goiter
M. Legumes

V. Study Exercises

A. Develop a mineral chart for foods in various food groups
B. Essay on health disorders attributable to mineral deficiencies
C. Essay on the myths of mineral cures for disease
D. Student personal mineral evaluation of food intake
E. Unit test

VI. Outcomes

A. The Student will have gained an understanding of the 15 minerals as either macrominerals or trace minerals ingested and related information or minimum standards recommended by nutritionist

VII. Resources

A. Vegetarianism in a Nutshell: 14-minute filmstrip
B. Vitamin Basics: filmstrips
C. Osteoporosis: Are You at Risk for Bone Disease?

VITAMINS

BEHAVIORAL OBJECTIVE - The Student will know the concepts that apply to all vitamins, function, deficiencies, recommended intake, dietary source for both fat soluble and water soluble vitamins.

MEASUREMENT: Oral and written test, student participation, informal discussion.

LEARNING ACTIVITY	RESOURCE
I. Objective (Specific) A. Know features used to classify, describe and distinguish vitamins B. Know major functions, effects of deficiency, signs of excessive intake, dietary source and intake recommendations for each of the 13 vitamins C. Understand differences of true vitamins from the non-vitamins sold as supplements D. Know concepts will apply to all vitamins E. Use information on nutrition labels to estimate vitamin amounts in various foods	
II. Pre-test	Teacher made
III. Content	
A. A well-chosen diet can supply all the vitamins most people need 1. most people mistakenly believe taking vitamins will give them pep and energy a. 40% of Americans take supplements regularly b. Americans spend $2 billion per year on vitamin and mineral supplements 2. claims for the benefits of vitamin supplements in the press sometimes cause people to take dangerously large doses	Nutrition for Living Pgs. 276-309
B. Vitamins are organic compounds that are present in small amounts in foods; they are needed in small amounts to regulate metabolic functions in the body 1. vitamins do not need to be digested before they can be absorbed, and vitamin molecules are used repeatedly in biochemical reactions 2. vitamins are distinguished from each other on the basis of their solubility in fat vs. water, the levels at which body tissues are saturated, and absorption efficiency	A History of Nutrition 1957, McCollum, E.V.

3. each vitamin has a unique structural configuration or set of configurations
    a. vitamin molecules contain carbon, hydrogen, oxygen, and sometimes nitrogen, sulfur, or cobalt
    b. provitamins are precursors that can be converted into a vitamin's active form
    c. different forms of a vitamin have different potencies, partly because of differences in absorption
    d. there is no functional difference between "natural" and synthetic vitamins
4. the toxicity of a vitamin varies with the solubility (fat-soluble vitamins accumulate in the body more readily than water-soluble vitamins), the form of the vitamin, and the duration of intake
5. oxygen, light, acidity/alkalinity, and time of exposure to these agents affect the stability of vitamins, but to different degrees with different vitamins
6. some vitamins are measured in terms of grams, milligrams, and micrograms; but others are measured in terms of equivalents that contain corrections for variations in potency among the vitamins' different forms

C. Vitamins have widespread effects throughout the body, and most vitamins are needed by every body cell — Present Knowledge in Nutrition, 1984, McLaren
1. vitamin A is a fat-soluble vitamin that has many forms
    a. vitamin A has preformed configurations (retinal, retinaldehyde, and retinoic acid) and several provitamins (beta-carotene being the most important)
    b. vitamin A is needed for cell development, especially for cartilage, bone, and epithelial tissue (cornea, mucous membranes, nasal lining, GI tract lining, genitourinary tract lining, and skin) and for light-sensitive pigments in the retina (rhodopsin and iodopsin)
        i. xerophthalmia is a form of blindness caused by keratinization of corneas due to an inadequate amount of vitamin A
        ii. keratinization of epithelial tissues occurs throughout the body with vitamin A deficiency, causing dry, rough skin and brittleness of the mucous membranes
        iii. night blindness is a defect in adaptation from bright lights to darkness, not as severe or irreversible as xerophthalmia, caused by lack of vitamin A

iv. vitamin A is thought to protect against some forms of cancer, but this is not a well established fact

c. retinal equivalents (REs) are the modern way to measure vitamin A because they take potency of its various forms into account, but the older International Units are still used in food composition tables
   i. the 1980 RDAs for vitamin A are 800 REs for women and 1,000 REs for men
   ii. the average vitamin A intake for adults exceeds the RDA, but intakes vary

d. fruits, vegetables, liver, eggs, and dairy products contain vitamin A
   i. because dark green vegetables and deep orange fruits and vegetables usually contain carotenes, they are good food sources of vitamin A
   ii. while liver is a very rich source of preformed vitamin A, eggs and dairy products contain smaller amounts of preformed vitamin A
   iii. preformed vitamin A accounts for 75% of the average intake of REs

e. vitamin A toxicity depends on the form ingested
   i. high intakes of carotenes from vegetables and fruits cause the skin to turn yellow, but this is not a serious health problem
   ii. overconsumption of preformed vitamin A causes elevated pressure of brain fluids
   iii. accutane (13-cis-retinoic acid) is used to treat severe cystic acne, but it can cause birth defects if used during pregnancy

2. the body can actually produce vitamin D when it is exposed to sunlight, and vitamin D occurs in foods as calciferol and ergosterol — Federation Proceedings, 1987, Holick, M.F. 46: 1876-1882
   a. vitamin D functions as a hormone that controls the level of calcium and phosphorus in the blood and bones, partly by enhancing absorption from the intestine and also by preventing excretion in the urine
   b. vitamin D deficiency leads to poorly mineralized bones that are characteristic of rickets in children and osteomalacia in adults
   c. RDAs range from 5 micrograms (ug) for adults to 10 ug for children, with an additional 5 ug during pregnancy
      i. adults who get enough sun exposure probably do not need vitamin D from food

ii. the amount of sunlight needed for vitamin D production in the skin varies with the amount of skin exposed, the amount of pigment in the skin, the intensity of the sunlight (time of day, season, latitude, sunscreen), and the person's age (increasing age and skin pigmentation reduce vitamin D production)

d. cod liver oil, fortified milk, and egg yolks are dietary sources of vitamin D

e. preformed vitamin D is the most toxic of all the vitamins; intakes do not have to exceed the RDS by much to cause problems, especially in infants

3. vitamin E is another fat-soluble vitamin that occurs in several forms

American Journal of Clinical Nutrition, 1984
Gulcter, G.R., Raynor, W.J., Farrel, P.M.

a. alpha-tocopherol is the most potent form of vitamin E; other tocopherols and tocotrienols are less active forms

b. vitamin E is mainly an antioxidant that protects substances like vitamin A and polyunsaturated fatty acids from oxidation

c. only premature infants and people who cannot absorb fat are known to develop vitamin D deficiency

d. the need for vitamin E varies with the intake of polyunsaturated fatty acids

e. the RDA for vitamin E is 10 equivalents (mg alpha-tocopherol) for adult males and 8 equivalents for adult females

f. vegetable oils and oils from other plant products (grains, nuts, seeds) are good sources of vitamin E

4. vitamin K is another fat-soluble vitamin that has more than one form

a. phylloquinone from green plants, menaquinones from bacteria, and synthetic menadione are forms of vitamin K

b. vitamin K is necessary for forming blood clots

c. 70-140 ug per day is the 1980 RDA safe and adequate range

d. since infants are born with low levels of vitamin K, they are given an injection or oral supplement to facilitate normal blood clotting

e. green vegetables, tea, liver, eggs, and milk fat are known to contain vitamin K

5. thiamin (B-1), riboflavin (B-2), and niacin are water-soluble vitamins that have related functions

a. nicotinamide is the active form of niacin, and nicotinic acid in foods can be simply converted to niacin; the amino acid tryptophan is a niacin precursor

b. these three vitamins are coenzymes that unite with enzyme precursors to form active enzymes used to release energy from carbohydrates, fats, proteins, amino acids, and alcohol
c. thiamin deficiency causes beriberi with damage to nerve/muscle systems, and sometimes severe edema
    i. beriberi can lead to death from heart failure
    ii. beriberi is rare in developed countries, except in alcoholics
d. riboflavin deficiency causes skin lesions
e. niacin deficiency causes pellagra (dermatitis, diarrhea, and dementia) which can be fatal
f. the need for these nutrients increases with the consumption of energy-rich foods
    i. the adult RDAs for thiamin and riboflavin are between 1 and 2 mg per day
    ii. niacin RDAs range between 13 and 19 niacin equivalents
    iii. average adult intakes are above RDAs for these nutrients
g. enriched and whole grain products, fruits, vegetables, milk, meats, and meat alternates are sources of these three nutrients
h. large quantities of niacin can produce toxic effects (transient flushing, headaches, and other symptoms)

6. vitamin B-6 is a water-soluble vitamin that occurs in several forms
a. pyriodoxine, pyridoxamine, and pyridoxal have the same potency
b. vitamin B-6 is a coenzyme for many reactions, especially for protein metabolism, including the production of nonessential amino acids and the conversion of tryptophan to niacin
c. vitamin B-6 deficiency shows up as nervous system problems (depression, confusion and convulsions)
d. vitamin B-6 needs are determined by protein intake; the RDAs for adults are 2.0 and 2.2 mg per day for adult women and men, respectively
e. the average intake of vitamin B-6 is less than RDA, but this has not resulted in widespread deficiency symptoms
f. meats, meat alternates, and bananas are good sources of vitamin B-6
g. nerve disorders result from taking over 100 times the RDA for vitamin B-6 for many weeks; this happens most often in treatment of premenstrual syndrome

7. folacin and vitamin B-12 are water-soluble coenzymes for DNA and RNA metabolism
    a. folacin is also called folate and refers to folic acid derivatives
    b. vitamin B-12 is any of several compounds called cobalamin, all of which contain cobalt
    c. cell division, transfer of single carbon units between certain molecules, and the metabolism of some amino acids require both these vitamins
    d. deficiency of either vitamin causes megaloblastic anemia; vitamin B-12 deficiency can also cause nerve damage
        i. megaloblastic anemia is identified by large, immature red blood cells
        ii. the two vitamins are somewhat interchangeable in treatment of megaloblastic anemia, but folacin cannot prevent the nerve damage of vitamin B-12 deficiency
    e. the folacin RDA for adults is 400 ug, and the vitamin B-12 RDA is 3 ug
        i. the folacin RDA doubles during pregnancy, and supplements are often prescribed
        ii. vitamin B-12 RDA for pregnancy is 4 ug, an amount easily consumed by all persons who eat animal foods; pregnant vegans should use vitamin B-12 supplements
    f. leafy vegetables and fruits are good sources of folacin, while only animal foods contain vitamin B-12
    g. intrinsic factor is a substance produced by the stomach lining
        i. without intrinsic factor, vitamin B-12 cannot be absorbed, and pernicious anemia results
        ii. elderly persons absorb less vitamin B-12 because they produce less intrinsic factor as they get older
    h. toxicity of these vitamins is unknown, except for the problem of folacin masking vitamin B-12 deficiency
8. pantothenic acid and biotin are water-soluble coenzymes
    a. both vitamins are used in the production of enzymes for energy metabolism; pantothenic acid is also used in the synthesis of other substances in the body
    b. these vitamins are widely distributed in foods, and deficiencies are rare

Modern Nutrition in Health & Disease, 1980
Herbert V., Colman, N., Jacob, E. -

i. egg whites contain avidin that binds to biotin and makes it unabsorbable
ii. genetic defects or consumption of huge quantities of raw egg whites can produce biotin deficiency

c. there is no commonly known toxicity associated with consumption of these vitamins
d. the RDA safe and adequate intake ranges are 4-7 mg for pantothenic acid and 100-200 ug for biotin; precise information on common intakes is not available

9. vitamin C is water-soluble, but it is not a coenzyme — Diet, Nutrition and Cancer, 1982, National Academy Press
   a. vitamin C is also called ascorbic acid and ascorbate
   b. vitamin C acts as an antioxidant, participates in collagen formulation, helps produce certain hormones and neurotransmitters, metabolizes some amino acids and vitamins, helps fight infections, improves iron absorption, and takes part in detoxifying certain substances in the liver
   c. deficiency of vitamin C is known as scurvy, a condition of weakness, bleeding gums, loose teeth, broken blood vessels, and lowered resistance to infection
   d. the adult RDA for vitamin C is 60 mg, an amount exceeded by most Americans
   e. vitamin C is found naturally in fruits and vegetables, and it is added to many other foods
   f. vitamin C supplementation is more frequent than any other nutrient
   g. vitamin C excesses can cause diarrhea, anemia, oxalate-type kidney stones, and interference with a test for colon cancer
   h. vitamin C supplements have been recommended for preventing and curing several diseases, most notably the common cold and cancer
      i. studies of vitamin C for prevention of colds show either no benefit or only a small reduction of incidence that could also be achieved by drinking an extra glass of orange juice each day
      ii. vitamin C has made some people feel better during the first days of a cold, and people in one study spent 1/2 day less at home with a cold, but the total duration of colds has not been known to decrease with vitamin C supplementation
      iii. vitamin C does not cure cancer, and the protective effect of vitamin C against the development of cancer is controversial

10. rutin, inositol, choline, carnitine, para-aminobenzoic acid, bioflavinoids, lipoic acid, ubiquinone, pangamic acid, and laetrile are not true vitamins but they are sometimes sold as supplements

D. Some import concepts apply to all vitamins
   1. vitamin deficiencies occur with limited diets (quantity and types of foods), poor absorption, and/or unusually high requirements
      a. except for vitamin A, vitamin deficiencies rarely occur one at a time
      b. vitamin deficiencies affect the whole body and sometimes cause general symptoms such as weakness, growth failure, or increased infections
      c. biochemical tests are needed to confirm vitamin deficiency when symptoms are present
      d. the onset of a vitamin deficiency is most rapid for vitamin C (two months) and slowest for vitamins A and B-12
   2. most toxicities occur with long-term use of supplements in excessive amounts
      a. some people are unaware of the possibility of harm from high doses of nutrients
      b. toxicities vary in speed of onset, but most involve megadoses (more than 10 times the RDA) for several months or years
   3. most healthy adults who eat a varied diet do not need vitamin supplements — Journal of the American Medical Association, 1987 Council of Scientific Affairs 257: 1929-1936
      a. vitamins may be legitimately prescribed by doctors as therapeutic agents for certain conditions
      b. supplements of 50-150% of U.S. RDA are useful for healthy people in some circumstances
         i. vegans need vitamin B-12 supplements; vegan children may also need riboflavin and vitamin D supplements
         ii. pregnant and lactating women have increased needs, especially for folacin
         iii. newborns need vitamin E
         iv. infants may need certain supplements, depending on the type of milk they are fed
         v. the elderly and people on weight-loss diets often have such low food intakes that a multivitamin supplement is recommended

E. Nutrition labels show the amounts of some vitamins in food in terms of the percent of U.S. RDA; you can convert these label figures to milligrams and micrograms by multiplying the given percentage by the appropriate U.S. RDA

IV. Study Vocabulary (Suggested)

A. Supplement
B. Synthetic
C. Toxicity
D. Xerophthalmia
E. Carotenes
F. Rickets
G. Osteomalacia
H. Dermalitis
I. Dementia
J. Folacin
K. Anemia
L. Intrinsic
M. Anti ocidant
N. Megadoses

V. Student Exercises

A. Develop concept map for each vitamin
B. Develop a vitamin chart for foods in various food groups
C. Develop an essay on:
    1. consequence of megadose
    2. supplements - are they as good as the advertisement?
    3. vitamins and supplements - myth or fact - do they prevent cancer?
D. Unit test

VI. Outcomes:

A. The student will have an understanding of the role vitamins play in a healthy body, what the facts are concerning vitamin dosage, information about supplements, and misconceptions concerning vitamins' role in disease prevention and control

NUTRITION FOR LIVING - COMPREHENSIVE EXAM

Dietetic Technician Program

I. MULTIPLE CHOICE

1. A serving of food has the following composition:
   -water 52 grams
   -protein 20 grams
   -carbohydrate 10 grams
   -fat 9 grams
   How many kcalories does it contain?
   a. 52 kcalories
   b. 91 kcalories
   c. 157 kcalories
   d. 201 kcalories

2. The percentage of healthy persons whose needs are covered by the RDA is approximately:
   a. 25%
   b. 58%
   c. 75%
   d. 98%

3. Which of the following are significant sources of energy?
   a. protein, carbohydrates, minerals
   b. vitamins, lipids, carbohydrates
   c. alcohol, protein, lipids
   d. carbohydrates, protein, vitamins

4. Nutrient overdoses are most commonly caused by:
   a. eating food combinations which are incompatible.
   b. eating higher than recommended amounts of nutrients in common foods.
   c. indiscriminate use of nutritional supplements.
   d. consuming food which contains by-products of bacterial metabolism.

5. Which of the following substances, when analyzed biochemically, would generally provide the <u>least</u> reliable measure of nutritional status?
   a. blood
   b. hair
   c. tissue
   d. urine

6. Which of the following meals contains foods from all four food groups?
   a. a sandwich containing two slices of whole wheat bread, cheese, lettuce, and mayonnaise; an apple, and a glass of milk
   b. a casserole with enriched noodles, ground beef, tomato sauce, and grated cheese; a green salad, and a glass of soda pop
   c. enriched crackers with cream cheese, bologna, sliced cucumber, and orange juice
   d. a peanut butter and banana sandwich on whole wheat bread

7. The most reliable of the following measures of nutrition status are:
   a. biochemical tests.
   b. anthropometric tests.
   c. appearance and well-being.
   d. hair analyses.

8. Which of the basic four food groups is <u>not</u> represented in a meal of a peanut butter sandwich on whole grain bread and a glass of whole milk?
   a. meats and meat alternates
   b. fruits and vegetables
   c. grain products
   d. milk and milk products

9. Joe is running in a 10-mile race tomorrow. He has heard the following pieces of advice about keeping himself safely hydrated. Which is most correct?
   a. He should consume fluids during the event only when he feels thirsty.
   b. He should drink salted water because sweat is a very concentrated salt solution and, with heavy exercise, sodium levels become depleted before body water.
   c. He should drink a fruit juice or sports drink for fluid replacement, since it is absorbed faster than water.
   d. He should drink chilled water before and during the event because it is absorbed faster.

10. What is the major difference between carbohydrates in bread and carbohydrates in a cola?
   a. The bread has all its carbohydrates in the form of fiber, while cola has no fiber.
   b. The carbohydrates in bread are more complex.
   c. The carbohydrates in the cola are less soluble.
   d. The bread has mostly disaccharides, and the cola has mostly polysaccharides.

11. Ann drinks two colas 45 minutes before her soccer match for quick energy. Fifteen minutes after the game has started, how can she expect her blood sugar to be affected compared to what it would have been if she had drunk an equal volume of plain water?
   a. Her blood sugar level would be lower after drinking the coke.
   b. Her blood sugar level would be higher after drinking the coke.
   c. Her blood sugar level would be same after drinking coke or water.
   d. Her blood sugar level would momentarily go to zero (and then return to normal).

12. Sugar is stored in the body as:
   a. cellulose.
   b. insulin.
   c. glycogen.
   d. glucagon.

13. The disease in which the pancreas produces so little insulin that insulin must be supplied to the body by injection is called:
    a. insulin-dependent diabetes.
    b. non-insulin-dependent diabetes.
    c. reactive hyperglycemia.
    d. reactive hypoglycemia.

14. Choose the most correct statement about the involvement of carbohydrates with the state of one's health.
    a. An excessive intake of sugar causes diabetes and heart disease.
    b. An increase in fiber intake may help prevent diverticular disease.
    c. A high simple sugar intake causes obesity.
    d. A decrease in fiber intake may help prevent colon cancer.

15. An adult should get at lease how much carbohydrates per day?
    a. 10-15 grams
    b. 10-15 milligrams,
    c. None; carbohydrates are not essential in the diet.
    d. 100 grams

16. "Dietary Goals for the United States" recommends that the average American carbohydrate intake should be:
    a. cut in half.
    b. increased to 50-60% of kcalories consumed.
    c. adjusted to about 30% of a day's kcalorie intake.
    d. decreased by 20% to allow for more protein intake.

17. Which of the following statements is not true regarding the "Basic Food Guide"?
    a. Some meat alternates are actually plant foods.
    b. Limited extra foods are low in nutrient density.
    c. Fruits and vegetables are in separate groups.
    d. Refined grain products are not considered members of the grain products group unless they are enriched or fortified.

18. According to the "US Dietary Guidelines", Americans should do all the following <u>except</u>:
    a. eat foods with less starch and sugar
    b. avoid too much sodium
    c. eat a variety of foods
    d. maintain desirable weight

19. Which of the following is <u>not</u> a function of one or more lipids?
    a. provide nine kcalories per gram
    b. provide linoleic acid which cannot be made in adequate quantities within the body
    c. facilitate the absorption of all vitamins and some minerals
    d. form part of cell membranes, certain hormones, and other body materials

20. Identify the correct match between a type of lipid and a food that contains a considerable amount of it.
    a. saturated fat - meats
    b. polyunsaturated fat - yogurt
    c. cholesterol - palm oil
    d. monounsaturated fat - coconut oil

21. Which of these pairs of terms is a correct match for a type of lipid and a food source?
    a. cholesterol - peanuts
    b. omega-3 fatty acids - fish
    c. monounsaturated fatty acids - coconut oil
    d. phospholipid - corn oil

22. Select the proper sequence of protein foods arranged from excellent to poor in terms of the quality of the protein they provide in the diet.
    a. eggs, vegetables, grains, meat
    b. meat, beans, vegetables, milk
    c. peanuts, grains, milk, gelatin
    d. eggs, meat, beans, gelatin

23. Substantial amounts of protein can be used for energy:
    a. only if carbohydrates and fat are present in the same meal with a protein containing adequate levels of the essential amino acids.
    b. only if carbohydrates and fat are consumed in excess of the body's energy needs.
    c. when pancreatic proteases are insufficient to facilitate nearly complete digestion of food proteins.
    d. if the energy level of the diet is inadequate.

24. Aspartame is:
    a. the cause of "Chinese restaurant syndrome".
    b. a common allergen in protein.
    c. a sugar substitute that is a dipeptide.
    d. a form of soybean isolate.

25. Regarding protein balance, a person is said to be in "negative balance" if:
    a. more nitrogen is lost (excreted) than is taken in (ingested).
    b. more nitrogen is taken in than is lost.
    c. equal amounts of nitrogen are taken in and excreted.
    d. a person is healing several days after a serious injury.

26. Diets which are high in protein (more than twice the RDA) can lead to:
    a. greater calcium excretion.
    b. insufficient intakes of fat.
    c. stomach ulcers due to excess production of digestive enzymes.
    d. protease in the urine.

27. Mark's protein need is about 55 grams per day, and his energy need is about 2500 kcalories per day. He has decided to increase his protein intake to 120 grams per day by adding a liquid protein product to his typical food intake. The most likely effect of this supplementation is:
    a. iron depletion.
    b. essential amino acid deficiency.
    c. marasmus.
    d. increase in body fat.

28. Which of the following statements is true regarding vitamin B-6?
    a. Pyridoxine supplements are sometimes used to treat symptoms associated with premenstrual syndrome, though the effectiveness has not been scientifically proven.
    b. Meats are extremely poor sources of this vitamin.
    c. No symptoms of toxicity have been reported for this water-soluble vitamin.
    d. A component of raw egg whites binds with this vitamin so that it cannot be absorbed from the intestine.

29. Identify which menu is <u>missing</u> a good source of the stated vitamin.
    a. vitamin A: turkey sandwich on white bread, potato chips, pumpkin pie
    b. vitamin C: chicken noodle casserole, cantaloupe and strawberry salad, iced tea
    c. folacin: sirloin steak, cottage cheese, chocolate cake
    d. vitamin E: waffles with vegetable margarine and maple syrup, orange juice

30. The RDA for vitamin C for adults is:
    a. 60 micrograms (60 ug).
    b. 60 milligrams (60 mg).
    c. 60 grams (60 g).
    d. 60 ascorbate equivalents (60 AE).

31. Which of the following statements is true?
    a. RDAs have been established for all the macrominerals, but some of the trace minerals have safe and adequate ranges instead of RDAs.
    b. Some minerals like fluoride may have beneficial effects on the body, but scientists do not agree on whether or not they are essential for life.
    c. Deficiencies of trace minerals are usually less important and deficiencies of macrominerals.
    d. Scientists identify the essentiality of a mineral by putting it into a test tube with a mixture of enzymes and observing whether any of the enzymes are more active with the mineral present.

32. Which of these food pairs contains iron in its most absorbable form?
    a. cheese and eggs
    b. beans and peanuts
    c. whole wheat bread and spinach
    d. beef and fish

33. Which mineral is present at a low level in this menu?
-Menu: hamburger, cola, french fries, apple pie
   a. phophorus
   b. sulfur
   c. calcium
   d. sodium

34. Which of the following can cause mottled teeth?
   a. use of iodized salt
   b. too much fluoride
   c. calcium deficiency
   d. use of antacids

35. According to a popular but often inaccurate author, "Calcium is used by the nerves in the transportation of impulses. When calcium is undersupplied, nerves become tense and irritable." When you are feeling grouchy and restless, this author recommends that you drink a glass of milk because "the calcium soothes the nerves, and restful sleep usually follows." This advice is misleading because:
   a. calcium is not involved in the transmission of nerve impulses.
   b. calcium levels in the blood and nerves do not change dramatically as a result of drinking a glass of milk.
   c. calcium in milk is only absorbed when the milk is consumed with a meal that contains meat or vitamin C.
   d. this practice could cause calcium toxicity, since the average American adult already consumes foods that provide two to three times the RDA for calcium.

36. Which of these amounts of sodium is within the safe and adequate range recommended for sodium intake?
   a. 20 milligrams
   b. 20 grams
   c. 2000 milligrams
   d. 2000 grams

37. In the process of osmosis:
   a. water moves across a selectively permeable membrane.
   b. ions move in one direction across a selectively permeable membrane.
   c. body proteins move across a selectively permeable membrane.
   d. ions cross a selectively permeable membrane in response to changes in body temperature.

38. Essential amino acids are different from nonessential amino acids because only essential amino acids:
   a. contain nitrogen in organic form.
   b. have a structure the body cannot make from other amino acids.
   c. provide essential minerals, in addition to nitrogen.
   d. provide 4 kcalories per gram.

II. MATCHING EXERCISES

Part 1

___ 1. nutrition assessment techniques	a. foods that do not belong to the basic food groups
___ 2. biochemical tests	b. chemical analyses of body substances
___ 3. anthropometric tests	c. methods of rating nutrition status either by measuring dietary intake or body substances
___ 4. skinfold caliper	d. a device for measuring the thickness of the skin and the underlying layer of fat
___ 5. limited extras	e. maximum level of storage capacity in the body
	f. external measurements of the body such as height, weight, and skinfold thickness

Part 2

___ 1. alimentary canal	a. circular muscles that regulate passage of materials in the GI tract
___ 2. digestion	b. slimy material produced by the mucosa
___ 3. absorption	c. chemical messengers that affect a process in a region of the body other than where they were produced
___ 4. lumen	d. the gastrointestinal tract; the main part of the digestive system that runs from the mouth to the anus
___ 5. mucus	e. the process of taking digested substances into the interior of the body
___ 6. sphincters	f. the process of breaking food down into substances small enough to be absorbed
___ 7. anus	g. the central space of the alimentary canal
___ 8. enzymes	h. proteins that speed up biochemical reactions
___ 9. hormones	i. the last sphincter in the GI tract
	j. the internal lining of the GI tract

III. SHORT ANSWERS

Select two (2) of the following questions and write brief answers in full sentences.

1. A commercial for supplements of Vitamin X features a movie star who says that taking Vitamin X made all her pimples disappear. What type of evidence is this for effectiveness of Vitamin X? Describe a human study that would provide more convincing scientific evidence for the ability of Vitamin X to make pimples go away.

2. Sara, an 18-year-old, has been on a diet of only grapefruit and yogurt for 2 months to lose weight. Analyze her diet according to the "Basic Food Guide", and tell which food groups are missing. Which vitamins and minerals are supplied by grapefruit and yogurt? List as least three minerals and three vitamins which are likely to be deficient in this diet. What advice would you give Sara to change her diet?

3. Plan a menu for one day for an adult which meets at least the minimum recommended by the "Daily Food Guide", and also takes into account the Dietary Guidelines with respect to lowering fat and cholesterol, reducing sodium and sugar, and increasing fiber. Describe how your menu meets these specific guidelines.

4. What is the relationship between cholesterol, HDL, and LDL in the blood, and cardiovascular disease? Describe specific ways to improve these blood lipid levels to reduce the risk of cardiovascular disease.

5. These are examples of claims made for two food products. Explain why they are misleading.
   - A vegetable oil advertises that it has no cholesterol
   - Snack crackers advertise that they are made with "all vegetable shortening", but the ingredient label says that they contain coconut or palm oil.

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